
CCME National Water Quality Index Workshop

A Path Forward for Consistent Implementation
and Reporting

November 24-25th, 2003
Halifax, Nova Scotia

Workshop Proceedings

March 2004

In memory of Geoff Howell

Workshop Steering and Organizing Committees

CCME Water Quality Index Steering Committee Members:

Wayne Bond

Environment Canada - KID,
National Indicators and
Reporting Office

Duncan Boyd

Ontario Ministry of Environment

Don Fox

New Brunswick Department of
Environment and Local
Government

Serge Hébert

Ministère de l'Environnement du
Québec

Geoff Howell

Environment Canada - KID,
Integrated Environmental
Applications Branch

Rob Kent

Environment Canada – National
Water Research Institute, Water
Quality Monitoring Branch

Haseen Khan

Newfoundland and Labrador
Department of Environment

Janine Murray

Environment Canada – National
Water Research Institute, Water
Quality Monitoring Branch

Scott Painter

Environment Canada – Ontario
Region

Doug Spry

Environment Canada –National
Guidelines and Standards Office

Les Swain (Chair)

British Columbia Ministry of
Water, Land, and Air Protection

Dwight Williamson

Manitoba Conservation

Organizing Committee Members:

Don Andersen

Environment Canada – National
Water Research Institute, Water
Quality Monitoring Branch

Wayne Bond

Environment Canada – KID,
National Indicators and Reporting
Office

Ria Demos

Environment Canada – Water
Priorities Branch

Lynda Fortin

Environment Canada - National
Guidelines and Standards Office

Geoff Howell

Environment Canada – KID,
Integrated Environmental
Applications Branch

Janine Murray

Environment Canada - National
Water Research Institute, Water
Quality Monitoring Branch

Angie Richard

Environment Canada – Water
Priorities Branch

Susan Roe (Chair)

Environment Canada- National
Guidelines and Standards Office

Uwe Schneider

Environment Canada - National
Guidelines and Standards Office

Doug Spry

Environment Canada – National
Guidelines and Standards Office

Preface

The need for reporting water quality information to the public became increasingly evident in the 1990's. At that time, traditional methods usually involved water quality experts trying to explain complex information to the public in very scientific terms, usually qualifying each statement made. When British Columbia began to work on this same need at about that time, interviews with ordinary citizens illustrated that they wanted simple answers to simple questions: can I eat the fish, drink the water, or swim in it without fear? A simple communication tool was needed.

The reason that experts at that time used qualifying statements was that there were no means to reduce the complex information into a simple communications tool. There were no adequate indices available – all were either too simple to be useful or too complex and impossible to use. For this reason, British Columbia developed the BC Water Quality Index that evolved in time to become the CCME Water Quality Index. The BC Index was designed for reporting on fresh or marine surface or ground waters, and sediments or tissue from aquatic life.

Just as the BC Index evolved, based on its use by others, into the CCME Index, it was always envisioned that the latter would also evolve using the knowledge gained when different jurisdictions used it and learned from that experience. In 2003, the time was right for the next step in the evolutionary process. Several Canadian jurisdictions, from East to West and North to South had used the Index in at least a cursory manner. In its 2003 report to the federal Minister of Finance, the National Round Table on the Environment and the Economy had endorsed the use of the Index for reporting on the state of the nation's fresh water to Canadians as one of six Environment and Sustainable Development Indicators.

The workshop was convened in Halifax, Nova Scotia on November 24-25, 2003 as a reporting and learning experience, to serve as a basis for the path forward to the regular, consistent reporting of the WQI at the regional and national level. It fulfilled the expectations of all the organizers and contributing jurisdictions. Most importantly, it served its stated purpose: to look for ways to improve the use of the Index, be that either in communicating how to use it to future users, or in getting the proper information gathered initially so that the Index could be effective.

The workshop was put together by many individuals who were either on the Organizing Committee or Steering Committee. These individuals and their organizations are identified on the preceding pages. However, special thanks must be made to Susan Roe from Environment Canada, who provided the organizational skills, the energy and the momentum to ensure the success of the event.

Finally, this workshop should not be considered as an isolated event but a forum from which a better communications tool will evolve. Let us use this forum again in the future so that the Index can continue to evolve and remain relevant for future generations.

Les Swain

**Chair, CCME Water Quality Index Steering Committee
British Columbia Ministry of Water, Land, and Air Protection**

Executive Summary

The Canadian Council of Ministers of the Environment (CCME) Water Quality Index (WQI) was endorsed in 2001 by the CCME as a tool for use by water quality specialists to communicate complex information about water quality to the public and water managers. Since its inception and endorsement by the CCME for use in Canadian jurisdictions, the WQI has been implemented in British Columbia, Alberta, Saskatchewan, Manitoba, Newfoundland and Labrador, the MacKenzie basin, and by a partnership of the Atlantic Provinces and Environment Canada. A related water quality index has been applied in Quebec. From this early experience with Index implementation, both strengths and challenges of the WQI have come to light, including issues related to monitoring, communication and public expectation, inputs, interpretation of the Index (including Index score categories), and the long-term feasibility and commitment by governments.

In May 2003, the National Round Table on the Environment and the Economy (NRTEE) in its report to the federal Minister of Finance recommended that the WQI be used as the national Freshwater Quality Indicator for reporting to Canadians as part of a small set of Environment and Sustainable Development Indicators on an annual basis with the federal budget statement.

In order to obtain feedback on how the WQI can be improved for consistent application Canada-wide, the CCME hosted a two-day workshop, *CCME National Water Quality Index Workshop*, in late November 2003 in Halifax, Nova Scotia. In advance of the workshop, Gartner Lee Limited conducted a survey of WQI users and other water quality experts to obtain feedback on the benefits and weaknesses, and applications of the Index. In general, the survey results indicated that users feel the WQI is a valuable communication tool, especially for non-technical audiences; however, several challenges need to be addressed to facilitate widespread use that will yield comparable results. The survey findings were summarized in a pre-workshop discussion paper, which provided important input to the workshop design and discussions.

The specific purpose of the workshop was to identify a path forward for consistent implementation and effective reporting for the WQI at the national and regional level on a regular basis (e.g., annually, bi-annually). The workshop consisted of 12 presentations highlighting experience using the Index, and small group discussions on the strengths, weaknesses, and opportunities for improvement of the Index. The breakout groups focused on five topics: key inputs for Index calculation; use of guidelines and objectives; monitoring and data; communication and reporting; and future uses of the WQI.

The result of the two-day workshop was a set of thirty recommendations on how to improve the WQI and move forward in achieving consistent application of the Index regionally and nationally. These recommendations are summarized in section 3.1 (p. 14) and elaborated in the remainder of that chapter.

Over the two-day workshop, delegates were enthusiastic and positive in dealing with the challenges presented within the workshop program. Several major themes emerged from the presentations, discussions in the breakout groups, and discussions in plenary. These themes are highlighted below:

- ***The WQI is a very useful communication tool.*** Participants agreed that the Water Quality Index is a powerful communication tool for conveying complex information on water quality in a comprehensible manner to the public and senior managers. Therefore, it is worthwhile investing time and energy in fine-tuning its application.
- ***Successful reporting of the WQI at the national level involves the full spectrum of a national environmental information support system.*** This support system includes monitoring and scientific analysis, data management and web services, Index calculation and interpretation, reporting and communication. .
- ***An Action Plan dealing with the concerns raised at the workshop should be developed, and concerns about index formulation dealt with, by September 2004.*** When the items in the Plan are sufficiently addressed, the CCME will be in a better position to move forward with regular reporting of the WQI on a regional and national basis. At the national level, regular reporting will likely mean annual reporting. Other time-frames may more appropriate locally or regionally. It is acknowledged that incremental improvements to the application of the WQI will continue to be made as experience is gained with the regular reporting of the Index.
- ***Comparison among different sites is possible using the WQI.*** Participants agreed that the WQI would return the most accurate result when calculated using a suite of locally relevant variables and guidelines. Results of indices calculated in this way would be comparable at the local, regional and national level as long as a consistent approach is followed and the appropriate details are reported.
- ***Flexibility is the WQI's greatest strength and greatest weakness.*** Flexibility of the WQI to incorporate different water quality variables and adjust guidelines to site-specific objectives was seen as one of its strengths. However, participants also considered its flexibility a weakness because of the potential for bias and subjective manipulation if inputs and/or objectives are inappropriately incorporated. Participants felt that additional detailed guidance is needed to facilitate more consistent and effective use of the WQI.
- ***Site-specific objectives are necessary.*** Participants felt that site-specific objectives are important to address the wide variety of site-specific conditions where water quality is monitored across the country. It was felt that more guidance is needed on how WQI users can develop these site-specific objectives when none exist.

- ***Improvements are needed in current monitoring systems.*** Current monitoring systems are not designed nor intended for national reporting. Existing water monitoring systems across Canada are issue-driven, and do not necessarily collect the data required for national reporting of water quality. Participants felt that more resources are needed to improve the quality and representation of water monitoring across the country.
- ***Clearer explanations of the purpose of the WQI and its limitations are needed in all communications.*** Participants felt that a clear description of what the WQI is, its purpose as a reporting and communication tool, and its limitations are needed with all future communications material and reporting for the WQI.
- ***The WQI needs to be understood in its proper context.*** The Index itself needs to be understood within the proper context of the whole chain of water quality information – from monitoring to data management and access to reporting.

In general, the outcome of the workshop reinforced that the WQI is a valuable tool for accurately communicating information, although it still needs reinforcement and guidance on specific issues.

Participants of the workshop felt that a priority activity is to develop an Action Plan to fine-tune the WQI and ensure that a nationally recommended approach for applying the Index is ready for widespread adoption within one year. They felt the CCME should commit to continuing in a leadership role in development and in the application of the WQI. As Risa Smith of Environment Canada commented in her opening remarks at the workshop: *“We need to take charge of how the Index will be used, because it will be used, and we need to make sure its use is credible.”*

The WQI Steering Committee, now a sub-group of the CCME Water Quality Task Group, will continue to meet to develop the WQI, and commits to developing and implementing an Action Plan to refine and implement the WQI for regular regional and national reporting.

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1.0 Introduction

1.1 CONTEXT

Water quality is a top of mind issue for Canadians today. Traditionally, reports on water quality have been very technical in nature, consisting of complex statistical summaries of multiple variables and data sets. This information is not meaningful to Canadians who, for example, want an answer to the question “What is the quality of my drinking water?” or “Is this lake healthy?” The Canadian Council of Ministers of the Environment (CCME) developed the Water Quality Index (WQI) to address this gap. The Index was developed first and foremost as a communication tool, to translate complex data on water quality into an overall integrated score ranging from “Excellent” to “Poor”.

The WQI was developed by the CCME Water Quality Guidelines Task Group, after a review of water quality indices used across Canada and internationally. It is based primarily on the water index formula developed by the British Columbia Ministry of Environment, Lands and Parks in the mid-1990s, refined with inputs from the Alberta Environment. The resulting CCME WQI looks at the scope, frequency and amplitude of the measured deviation of water quality from a set of guidelines – national, provincial, or site-specific guidelines as applicable.

Since its inception and endorsement by the CCME in September 2001 for use in Canadian jurisdictions, the Index has been used for water quality reporting in several jurisdictions, including but not limited to Alberta, British Columbia, Saskatchewan, Manitoba, Newfoundland and Labrador, and by a partnership of the Atlantic Provinces and Environment Canada. From this early experience with Index implementation, both strengths and challenges of the WQI have come to light, including issues relating to monitoring, communication and public expectation, inputs, interpretation of the Index, and the long-term feasibility and commitment by governments.

In response, a two-day workshop titled *CCME National Water Quality Index Workshop* was held in Halifax, Nova Scotia on November 24-25, 2003 under the auspices of the CCME, in order to obtain feedback on how the WQI can be improved and enhanced for consistent application Canada-wide. In advance of the workshop, Gartner Lee Limited conducted a survey¹ of WQI users and other water quality experts in order to obtain preliminary feedback on the benefits and weaknesses of the Index, its range of application, and opportunities for enhancement. The overall message from the survey was that the WQI is a valuable communication tool, especially for non-technical audiences; however, there are several challenges that need to be addressed to facilitate widespread use.

The importance of fine-tuning the Index has recently been heightened as the WQI has been approved for use as one of the six Environment and Sustainable Development Indicators recommended by the National Round Table on the Environment and the Economy (NTRTEE) in its May 2003 report for use by the federal Minister of Finance in the annual budget statement. As Risa Smith of Environment Canada commented in her opening remarks at the

¹ Results of this survey can be found in the report entitled *A Report on the Application of the CCME Water Quality Index*. Gartner Lee Limited, 2003.

workshop: *“We need to take charge of how the Index will be used, because it will be used, and we need to make sure its use is credible.”*

1.2 WORKSHOP PURPOSE AND FORMAT

The main purpose of the Water Quality Index workshop was to seek feedback from water quality experts and practitioners who have used the WQI in order to *“identify a path forward for consistent implementation and effective reporting for the WQI at the national and regional level.”* The focus of the workshop was on how to move forward with the WQI, rather than concentrating on past challenges associated with its development. The workshop was designed to produce a set of recommendations on how the WQI can be enhanced for widespread use, looking at different perspectives including inputs, objectives, monitoring and data, reporting and future use of the Index.

The two-day workshop was broken up into plenary presentations by keynote speakers, and small group discussions (please see the workshop agenda in Appendix A). The twelve presentations addressed topics including an overview of the WQI, lessons learned from using the Index, and reporting with the WQI and the implications for monitoring.

Participants met in breakout groups on both days of the workshop for discussions on specific topics. The five topics were identified based on the results summarized in the pre-workshop report by Gartner Lee. The five breakout topics were:

- (1) Key Inputs for Index Calculation;
- (2) Use of Water Quality Guidelines and Objectives;
- (3) Monitoring and Data;
- (4) Reporting and Communicating the WQI; and
- (5) Future Use of WQI.

Participants in the breakout groups were charged with identifying the benefits, challenges and ways to address the challenges of using the WQI with respect to their particular topic, and to come up with recommendations on how to improve the Index. All participants gathered in plenary at the conclusion of each day of the workshop to review and discuss the proposed recommendations.

A total of 46 participants attended the workshop, representing all provinces and territories across Canada except for Manitoba, the Yukon and Nunavut. A list of workshop participants can be found in Appendix B.

1.3 OVERVIEW OF THE REPORT

The Workshop Proceedings provides a summary of the presentations and small group discussions along with the resulting recommendations. Section 2 provides a brief overview of each of the twelve presentations, and summarizes the key messages articulated by each presenter. Section 3 presents the feedback provided by each of the five breakout groups. Finally, Section 4 discusses the next steps and path forward for the WQI following the workshop.

2.0 Overview of Workshop Presentations

Twelve presentations were organized into three plenary sessions over the two-day workshop. The three plenary sessions addressed (1) an overview of the WQI, (2) what has been learned about the WQI to date, and (3) reporting the WQI and implications for monitoring. A summary of each presentation is provided below, highlighting the strengths, challenges and suggestions for improvement of the WQI (where appropriate). The abstracts for each presentation can be found in Appendix C.

2.1 PLENARY SESSION I: OVERVIEW OF THE WQI – WHERE WE’RE AT

The Water Quality Index – Its Early Testing, Application and Results. Author: Les Swain, B.C. Ministry of Water, Land and Air Protection

Presenter: Les Swain

The CCME WQI was based to a large extent on an index developed by the B.C. Ministry of Environment in the mid 1990’s. This index was modified, in part using information from the Alberta Environment. In 1985, B.C. began to manage high priority watersheds using site-specific water quality objectives (guidelines altered to take account of ameliorating factors or local conditions). In 1994, B.C. started the two-year development of a water quality index. The three main factors in calculating the index were the number of variables for which the objectives are not attained (scope – F1), the number of times and places the objectives are not attained (frequency – F2), and the maximum extent that the objectives were not attained (amplitude – F3). The scale ranged from Excellent (0 to 3) to Poor (60-100). Some lessons learned from the B.C. index are that it is important to use at least three years of data, and that the public appreciates the information that results from using an index.

The CCME Index was developed by a sub-committee chaired by Bernie Neary, which evaluated the B.C. approach, tested the factors, and modified F3 using work from Alberta. The resulting Index reversed the ranking, so that Excellent scored 95-100, and Poor scored 0-44. Advice for the use of WQI Version “1.0” is to use site specific objectives rather than national or regional guidelines to calculate the Index, use a minimum of three years of data on three variables, and test the ranges. One misconception was that the WQI is too simplistic to be valid, however, the presenter commented that “*if we as scientists can use our knowledge to produce the Index, then the simple answer it gives should not be a problem.*”

Reporting on the CCME Water Quality Index as the Proposed National Freshwater Quality Indicator. Authors: Wayne Bond (National Indicators Reporting Office, Environment Canada) and Vincent Mercier (Environment Canada)

Presenter: Wayne Bond

The National Round Table on the Environment and the Economy (NTREE) was asked in 2000 to recommend a small set of environment and sustainable development indicators (ESDIs). After consultations, six ESDIs were recommended: air quality trends, freshwater quality, greenhouse gas emissions, forest cover, extent of wetlands and educational attainment. In 2002, the NTREE ESDI study approved the adoption of the CCME WQI as the

basis for a Freshwater Quality Indicator. As part of this adoption, the ESDI committee required that the WQI be reported on a national set of data from the federal level and all provinces/territories.

The approach taken for the first national reporting of the WQI in the NRTEE report (May 2003) included using existing index calculations in provinces that had them (Quebec, the western provinces), and calculating the WQI from federal or provincial data for other provinces. All jurisdictions were reported on except for Yukon and Nunavut. For all calculations, a minimum of 3 years of data was used, and the focus was on the protection of aquatic life. 32.6% of the water quality sampling stations rated “Good” for the WQI, and 21% were rated as “Marginal” or “Poor” water quality. These results were preliminary, and were the first approximation for a national picture of ambient freshwater quality. Future opportunities for reporting include annual reporting as part of the ESDI in Federal Budget statements, regular reporting at the national level by Environment Canada and Statistics Canada, and integrating the Index into a national environmental information system (CISE Water).

Summary of Feedback on the WQI: WQI and National Reporting	
<p>Strengths</p> <ul style="list-style-type: none"> • Flexibility of Index • Can potentially be used for groundwater – the important factor is the guidelines or site specific objectives <p>Weaknesses/Challenges</p> <ul style="list-style-type: none"> • Inconsistency of geographic representation • Inconsistency in the frequency and duration of sampling 	<p>Suggestions for Improvement</p> <ul style="list-style-type: none"> • More consistency in geographic coverage • Stable long-term ambient water monitoring • Agreement on national representation of sites • Nationally distributed water quality database (CISE Water) • More consistency in the index between Quebec and CCME • More guidance in applying the WQI • Direction for state of the environment reporting

2.2 PLENARY SESSION II: WHAT WE HAVE LEARNED

Applying the CCME Water Quality Index in Atlantic Canada and Lessons Learned.
Authors: Vincent Mercier (National Indicators and Reporting Office, Environment Canada) and Don Fox (New Brunswick Department of Environment and Local Government)

Presenter: Vincent Mercier

The Atlantic Pilot Project aimed to test and fine-tune the CCME WQI for monitoring water quality issues and natural conditions found in the four Atlantic Provinces. It represented a small-scale test of the range of issues that could be looked at on a national scale. Twenty-five water bodies were selected, covering a wide range of ecosystems and water issues in the provinces. Known or possible uses for each water body were identified, and criteria were established for the application of the WQI. Looking at protection of aquatic life, 10 of the 25 water bodies were rated as “Fair”.

Several challenges were identified during the pilot project. Some water systems had naturally high levels of substances such as Aluminum, Iron and Copper. Detection levels for Cadmium were above the CCME guidelines. The F1 factor (scope) tended to drive the result of the Index. There was difficulty in calculating the Index for recreational uses because of a limited number of measurable variables, leading to conflicting messages (e.g., fish kills in PEI yet the WQI for the protection of aquatic life could be good because of the transient nature of run-off events). Questions that arose during the study included:

- Should the WQI be a general indicator of water quality, or should it only track the stresses on water quality caused by human activities?
- Should all variables available be included, or only those indicative of the stresses on WQ by human activity?
- What is the process for selecting objectives – if there are no provincial guidelines (the case in the Atlantic Provinces) should the CCME objectives be used, or should a study be conducted to set site-specific water quality objectives?
- Should there be a core list of variables to compare to the WQ objectives?
- Which beneficial uses should be considered – present, or potential uses? Or only the most stringent – the protection of aquatic life?

The conclusions of the study were that the WQI can be applied to all four provinces, with each province determining how to derive or adopt objectives. When designing the monitoring program, it is important to think about how the information and data will be communicated, and a stronger coordinated effort is needed between water quality data management and WQI reporting to the public.

Summary of Feedback on the WQI: Use of WQI in Atlantic Provinces	
<p>Strengths</p> <ul style="list-style-type: none"> Flexibility of Index <p>Weaknesses/Challenges</p> <ul style="list-style-type: none"> F1 driving the Index Difficult to find variables for recreational use (usually more aesthetics) Natural areas high in metals Detection levels of Cadmium above the CCME guidelines 	<p>Suggestions for Improvement</p> <ul style="list-style-type: none"> Site-specific objectives can address the F1 challenge Clearly identify what the Index should indicate (natural water quality or only the effects of human induced stressors) Be up-front about limitations, gaps and weaknesses of the Index Interpret the scores with clear messages in reporting

Taking the Canada Water Quality Index for a Test Drive. Authors: Scott Painter and Jasmine Waltho (Environment Canada)

Presenter: Scott Painter

The sensitivity of the WQI to variation was tested, looking at the selection of guidelines, selection of variables, time period and sampling design. Fifty sites were chosen with long-term data sets from 1997-2002 and 30 chemical variables were used. Provincial and CCME aquatic life protection guidelines were used. The WQI was calculated for several different scenarios: averaging multiple years of data (two years, three years, four years, etc.), calculating each single year separately, varying the number of variables used, and varying which variables were used in the tests.

The results illustrated that the application of the WQI to an existing monitoring program must be considered carefully to ensure that representation of the environmental condition is reasonable. The design of most monitoring programs has very specific objectives and time periods, for example sampling in February and March only during spring run-off. However, in order to assess the protection of aquatic life, sampling needs to be done at a time of year (summer, fall) when biological data are available. The WQI may not be immediately sensitive to all management actions, for example if new sewage treatment practices were adopted, results would not be detected for a few years. This raises the question of how many years of data should be used? The F2 factor (frequency) was found to cause difficulty, as including more and more data in the calculations increases the chance of capturing an exceedence that will affect the final score. Also, certain variables were found to drive the Index – specifically nitrite, total phosphorus, zinc, and copper.

Summary of Feedback on the WQI: WQI Test Drive	
<p>Strengths</p> <ul style="list-style-type: none"> Tool for managers to communicate water quality results <p>Weaknesses/Challenges</p> <ul style="list-style-type: none"> F2 (frequency) driving the Index Number of years of data used influences WQI values Certain variables drive the Index (copper, iron, nitrite, total phosphorus) 	<p>Suggestions for Improvement</p> <ul style="list-style-type: none"> Careful consideration of time periods and variables used Recommend minimum 28 observations, based on monthly program, April to October, for 4 years

Experiences with Application of the CCME Water Quality Index. Authors: Haseen Khan and Amir Ali Khan (Newfoundland and Labrador Department of Environment)

Presenter: Haseen Khan

The CCME WQI was adapted for two applications in the province of Newfoundland and Labrador. The first application was to communicate the results of the province's drinking water quality monitoring program, and the second was to rank water bodies as potential drinking water supplies.

There are 600 public water supply systems in the province, and results are reported through a quarterly and annual report. The reports are positively received, however there is a limited ability for consumers to interpret the results and answer the question "What is the quality of my drinking water?" In preliminary testing, looking at tap water data from 17 water supply systems, there was encouraging agreement between expert opinion and the WQI results. However a further level of distinction is necessary between the "Good" and "Very Good" levels. Data for implementing the WQI was taken from the provincial water quality database. Results showed that the WQI would be applicable for communicating information about contaminants, boil water advisories, and perceived water quality (aesthetic) through the provincial database. The data is currently undergoing testing in the field.

For the second application, there is a provincial need for a relative ranking of water bodies. This application involved testing the feasibility of a ranking technique based on properties of the Normal distribution. Ambient water quality was analyzed from 110 sites, using data from 1986 to 2000. The WQI was calculated, and tested for Normality. Although the results were close to Normal, they were not very conclusive and a Box Cox transformation was used to achieve Normality. Conclusions from the study were that the WQI categories are applicable to a variety of situations, but that the "Good" and "Marginal" categories are too broad. Any future CCME work should consider refinement between these categories. This approach to Index value categorization would be useful for applications that would benefit from categories independent of subjectiveness.

Summary of Feedback on the WQI: WQI in Newfoundland and Labrador	
<p>Strengths</p> <ul style="list-style-type: none"> • Tool for managers to communicate water quality results to decision-makers and the public 	<p>Suggestions for Improvement</p> <ul style="list-style-type: none"> • Refinement of categories – especially "Good" and "Marginal" • Sensitivity of the WQI to variable selection

Comparison of the CCME WQI and the Québec IQBP. Author: Serge Hébert (Québec Ministry of the Environment)

Presenter: Serge Hébert

The State of Environment Branch of the Québec Ministry of the Environment conducted a study to measure the similarities and differences between the WQI and the Québec water quality index, the IQBP. In terms of the classification systems, the IQBP has one extra category in the low end, “Very Poor”, and combines the WQI category of “Excellent” and “Good” into one category with a wider range. The IQBP is calculated by looking at 7 sub-indices – fecal coliforms, phosphorus, turbidity, suspended solids, chlorophyll a, NH₃-NH₄, and NO₂-NO₃. The IQBP is calculated as the lowest number of the calculated sub-indices.

The IQBP and the WQI were calculated on the same data for the St. Lawrence River and rivers across the province under three tests that varied the selection of objectives. The WQI and IQBP water quality classes disagreed at 40% of the sampling sites. The conclusion of the study was that the WQI and IQBP are not comparable and cannot be used together to produce a national picture. Challenges found with the WQI were both a lack of sensitivity and too much sensitivity in different cases, with the F1 factor having too much weight in the formula.

Summary of Feedback on the WQI: WQI versus IQBP	
Weaknesses/Challenges <ul style="list-style-type: none"> • Too much sensitivity in some cases • Lack of sensitivity in others • Weight of F1 (scope) in calculation 	Suggestions for Improvement <ul style="list-style-type: none"> • Take account of the frequency of samples that show exceedences

A Report on the Application of the CCME Water Quality Index. Author: Bernie Neary (Gartner Lee Consultants)

Presenter: Bernie Neary

The WQI was endorsed by the CCME in 2001, and since that time several provincial and federal agencies have used the Index. A survey was designed and administered to WQI users in October 2003 to determine the success and lessons learned in using the WQI to date. A total of 35 responses were obtained out of 74 surveys that were distributed. Respondents identified strengths and weaknesses of the Index, and rated it as a reporting and monitoring tool. Respondents were representative of all provinces and territories across Canada, except for Nunavut and Manitoba.

Key water quality issues raised from the survey were inadequacy of current monitoring data, monitoring gaps, problems with communicating water quality information and problems with coordination of water management efforts. All respondents had used a water index, and most had used the CCME WQI. Respondents felt that key strengths of the Index include providing an understandable communication tool, flexibility, simplicity, ease for spatial and temporal comparisons and the ease of use. Weaknesses included oversimplification, questionable categories, sensitivity to variable selection, difficulties with site comparisons, lack of guidance for application, poor water quality ratings for pristine areas, and potential for

misinterpretation and misuse. The majority of respondents used multiple sources for objectives for calculating the Index. More participants felt that the WQI was a good tool for reporting out locally than regionally or nationally. Twenty seven respondents felt that a nationally distributed database was useful, however data formatting, maintenance, quality and ownership were considered challenges. There was some concern about the scientific validity of the WQI as it had not yet been published in a refereed journal. In general participants felt that there was a need for more guidance on variable selection and a sensitivity analysis.

Summary of Feedback on the WQI: WQI User Survey	
<p>Strengths</p> <ul style="list-style-type: none"> • Valuable communication tool • Understandable by non-technical audiences • Flexibility • Easy to use and calculate • Allows comparison of various sites and regions 	<p>Weaknesses/Challenges</p> <ul style="list-style-type: none"> • Oversimplifies • Potential for misuse • Needs further validation • Can produce values indicating poor water quality at pristine sites, given high natural background levels of some metals

Comparison of Canadian and French Water Quality Indices. Author: Haseen Khan Newfoundland and Labrador Department of Environment)

Presenter: Haseen Khan

The French water index, the SEQ, was established by the France Ministry of Environment and Regional Water Agencies. It includes a three-part system for river quality assessment, looking at: (1) physical aspects, or degree of artificiality of riverbed and banks; (2) water, or the physiochemical quality of water; and (3) biological aspects, or the status of biological communities. The purpose of the SEQ is to evaluate the quality of water from three different viewpoints, to identify changes in water quality or physical environment that have led to observed biological imbalances, and to evaluate the effect of changes on human use or natural functions of the water course. Variables of the same nature for the SEQ are grouped together as 15 main indicators. Each indicator is evaluated by water quality and by the suitability of water for various uses. There are five water quality classes, which relate to the ability of water to support life and the suitability for ensuring human health. Results are calculated on an individual sample, annual or multiple year basis (only 5 years of data can be compared at a time). Water quality for each indicator is determined by the least favorable parameter.

The comparison shows that there is a correlation in trend between the French SEQ and the Canadian WQI, however WQI values are consistently lower than those of the SEQ by 10-30 index points. Comparison is difficult given the major difference in methodology in calculating the two indices. The WQI gives a more conservative evaluation of water quality, both in terms of Index values and suitability for various uses. Both indices have their strengths and their weaknesses.

Canadian WQI	
<p>Strengths</p> <ul style="list-style-type: none"> • Looks at scope, frequency and amplitude of failure of all physio-chemical water quality data <p>Weaknesses/Challenges</p> <ul style="list-style-type: none"> • Does not incorporate physical watercourse characteristics 	<p>Suggestions for Improvement</p> <ul style="list-style-type: none"> • Think about use of WQI as a planning tool • Make the triggers of water quality problems more easily identified within the WQI • Consider integrating physical characteristics of the watercourse and biological health of the aquatic community into the WQI
French SEQ	
<p>Strengths</p> <ul style="list-style-type: none"> • Individual sample index values can be calculated • Effective visual presentation of results • Provides assessment of physio-chemical quality of water • Qualifies effect on biological function and potential water uses • Identifies indicators that are the chief cause of water quality problems • Enables restoration targets to be set 	<p>Weaknesses/Challenges</p> <ul style="list-style-type: none"> • Guideline matrices are subjective • Weighting towards the lowest index value calculated • Only five years of consecutive data can be compared at a time • No overall water quality index value or class • Visual presentation is quite complex for the general public

2.3 PLENARY SESSION III: REPORTING USING THE WQI AND MONITORING IMPLICATIONS

Water Quality Monitoring in Canada – Where Are We? Authors: Robert Kent, Janine Murray, Don Andersen, Chris Lochner, Isaac Wong and Dave Lam (Water Quality Monitoring Branch, Environment Canada)

Presenter: Janine Murray

Water quality is one of the top environmental issues for Canadians. As public awareness increases, so do the concerns and expectations relating to water quality and the overall health of Canadian freshwater ecosystems. Water quality monitoring in Canada is currently fragmented. There has been a shift from broad-spectrum programs to focused issue-specific programs, and there is limited integration of Canada-wide, basin-wide, and regional pictures. To address these issues, the CCME Ministers agreed to link and co-ordinate existing water quality monitoring networks. A Monitoring Sub-Group was established under the CCME Water Quality Task Group to focus efforts on this commitment. To date this group has held a national experts workshop, conducted an inventory of water quality monitoring in federal and provincial jurisdictions, and has initiated a project to prepare a Canada-wide Framework for Water Quality Monitoring.

Looking at Environment Canada's monitoring sites, within the Environmental Monitoring Inventory (EMI), it is apparent that programs are concentrated in populated areas and are primarily regionally-implemented, that shorter-term issue-based surveillance is more common, and that long term programs focus on transboundary waters. A metadata inventory of water quality monitoring activities in all CCME jurisdictions has been developed, entitled the Canada-wide Water Quality Data Referencing Network. This network is the first

inventory of its kind, consisting of a metadata inventory of water quality monitoring activities in all CCME jurisdictions. The Network includes search engines, data summaries and GIS-based mapping tools. Future phases will include data accessibility and interpretation, and decision-support applications. The Network is supported under the Canadian Information System for the Environment (CISE).

A Canada-wide Framework for Water Quality Monitoring is being developed under the CCME that will provide guiding principles related to the purpose, conduct and results of water quality monitoring network development in Canada. The Framework will incorporate results from the Nov 24-25 WQI workshop, and is projected for completion in 2004.

Summary of Feedback: WQI and Monitoring	
<p>Strengths</p> <ul style="list-style-type: none"> The WQI is an important and effective reporting tool for integrating and simplifying complex information 	<p>Suggestions for Improvement</p> <ul style="list-style-type: none"> Monitoring should be guided by the questions raised by the public, science and management communities Need to encourage strategic integrated monitoring programs

Application of CCME Water Quality Index (CCME WQI) to Various Sites in the Mackenzie River Basin. Authors: Ashok Lumb (Environment Canada), Doug Halliwell (Environment Canada), and Tribeni Sharma (St. Francis Xavier University)

Presenter: Doug Halliwell

The CCME WQI was applied to 6 water quality sites in the Mackenzie River basin: Mackenzie River at Fort Providence, at Strong Point, at Norman Wells, above Arctic Red River, Great Bear River, and Camsell River. These sites represented four Geological Regions and four terrestrial ecozones. Seasonal trends, long-term temporal trends and spatial trends were shown, by calculating decadal CCME WQIs. The WQI was calculated for overall use of water, drinking use and protection of aquatic species. Challenges with the data sets used were reduced sampling frequencies from limited resources and high costs, and variation in the frequency of sampling.

Overall, drinking water and aquatic use WQIs at four Mackenzie Main Stream sites are categorized as 'Fair', and at two Great Bear Lake sites as 'Fair' or 'Excellent'. Physical and trace metals were found to be mostly of natural origin, derived from geologic regions with high local geochemical backgrounds. Camsell River may be an exception to this, as nearby orphaned metal mines were closed in the 1980s and 1990s and may be impacting water quality. Simulated WQIs show that the WQI categories would be "Excellent" to "Good" if turbidity, colour, and some total metals were removed from raw source waters.

Conclusions from the research were that WQIs based on Canadian water quality guidelines are better for broad, regional spatial trend analyses. Site-specific objective WQIs yield higher values, but show real complexities in spatial trends due to local biogeochemical backgrounds

and cycling processes. WQIs using site-specific objectives are preferred when assessing ecosystem health more locally.

Reporting on the Water Quality Index Through CISE: Newfoundland Pilot Study.
Authors: Geoff Howell (Environment Canada) and Haseen Khan (Newfoundland and Labrador Department of Environment)

Presenter: Geoff Howell

The Canada and Newfoundland/Labrador Aqua Link (CANAL) is a collaborative project under the Canada Newfoundland Water Quality Monitoring Agreement. It was designed to build on work in progress, including building a water quality index calculator, station profiles and the development of on-line systems. The CANAL project was realized through the processing of water quality monitoring data, updating the Envirodat database, redesigning the WQI calculator for a web service, and developing/updating a Site Profile database, among other activities. For the user, CANAL, as a web service, provides a seamless link to all available water quality data, regardless of source.

CANAL uses a mapping interface to provide direct access to detailed information of 110 water quality stations in Newfoundland and Labrador. Users can get detailed station and watershed profiles, can extract water quality data for the station, and view individual samples. The station profile pulls information from the source each time, so if something is changed at the source this is immediately conveyed to the system. CANAL charts bacteriological data and conditions and calculates the WQI for drinking water, recreation and aquatic life. The intended audiences are managers, scientists and the general public. Sections of the tool can be password protected for more specialized access and use. The system has been separated into three services (Objectives, Parameters and Calculator), and the two management services can only be changed by database management or scientists. Next steps for the program include completing the WQI calculator web service, modifying calculator rules, ground-truthing the site documentation, developing a turbidity flagging procedure, and publishing the website.

Applications of the Water Quality Index to Sediment of the Lower Great Lakes. ***Authors: Scott Painter, Dr. Chris Marvin, and Dr. Lee Grapentine (Environment Canada)***

Presenter: Scott Painter

A sediment quality index (SQI) was developed based on the methods used to calculate the Canadian Water Quality Index. It therefore included three elements: scope, area frequency and amplitude. A modified SQI was also developed that used only the scope and amplitude factors, to compute an index score per site with no grouping of sites. The SQI was applied to assess sediment quality in Lakes Erie and Ontario, and several Areas of Concern. Over 30 chemicals were used, including trace metals and organochlorines. Values of the index were verified with benthic invertebrate ecologists to see if the ratings of “Poor”, “Good” etc. matched with their expert assessment of the sites. There was general consensus between the benthic invertebrate ecologists and the calculated values of the SQI.

3.0 Feedback from the Breakout Groups

Participants were divided into the five topic-based breakout groups for two sessions. Each group was charged with discussing the benefits and challenges of the WQI from the perspectives of their group's topic, and to come up with a set of recommendations on how the Index can be improved. The overall format of the breakout group discussions, held over two sessions, was to:

- Explore the issues and topics to be discussed;
- Identify potential opportunities and solutions to address each issue;
- Draft recommendations on how to improve the WQI; and
- Provide specific guidance and actions steps needed to implement the recommendations.

Several groups had additional specific questions to address in discussion. These can be found in the *Guidance for the Breakout Sessions* document in Appendix D.

The following sections provide a synthesis of findings from the five breakout groups, and document the feedback and recommendations obtained from each session.

3.1 SYNTHESIS OF FINDINGS

Strengths and Benefits of the WQI

- Flexibility with respect to input variables and guidelines/objectives
- Reflects input from experts
- Simplifies statistically complex data
- It is sensitive to jurisdictional requirements
- Good tool to reflect water quality at a site
- Management tool for man-made influences
- Easy to calculate
- Provides a plain language report card
- Could encourage consistency in monitoring programs
- Provides a link between what we're doing and why
- Highlights the value of monitoring and water quality in general from the perspective of the public
- Has the potential to "personalize" water for the public
- Encourages the use of data in both analysis and reporting
- Can confirm and/or remove current misinformation or misrepresentations
- It meets the needs and interests of the public

Weaknesses of the WQI

- Flexibility
- Factor 1 (F1; scope, number of variables) can saturate very quickly if there are too few variables or many covarying parameters, and it has too much weight in the WQI
- Lack of guidance on which variables to use, and protocols for sub-indices
- Lack of clarity on the purpose of the Index
- Lack of guidance for deriving site-specific guidelines/objectives (e.g., use of the 90th percentile at a pristine or reference site to determine an objective, use of background concentrations)
- Site-specific water quality objectives may not be available and may take a lot of time and effort to obtain
- WQI is open to bias
- Lack of data
- Lack of consistency in use of the WQI
- Lack of geographical representation
- No link with biological indicators/data
- No clear definition of water quality or the questions being asked
- Comparing provinces with respect to water is a challenge
- WQI only provides a partial story about water quality

Recommendations

The following is the complete set of recommendations produced by the five breakout sessions.

1. Establish a **core set of variables** that can be used to calculate the WQI for the purposes of reporting at the national, regional and local levels. The “core set” is a selection of variables intended to provide a “starting point” for calculating the WQI where little is known about the water quality and its natural and anthropogenic stresses. Site-specific customization of this “core set” is recommended whenever possible.
2. Recognizing that in order to address local conditions, additional, site-specific variables will be needed to calculate the WQI, **consistent, detailed guidance should be provided to Index practitioners regarding the selection and use of additional variables.** Overall, it is recommended including only relevant variables, which could include those central variables plus, for example, metals and/or pesticides and/or nutrients.
3. At a minimum, **the frequency of sampling should be four samples per year (minimum one per season).** A three-year rolling average of the data should be used as a basis for calculating the Index. This recommendation is contingent on the results of a sensitivity analysis. Further, water quality samples must be collected as part of a well designed, representative, surface water quality monitoring program.
4. Develop and implement a **sensitivity analysis** to evaluate optimum number of variables, sampling, frequency, and duration to include in the WQI calculation.

5. **Clarify the purpose and application** of the WQI in order to provide guidance and support on the selection of thresholds.
6. **Resolve the issue that using the 90th percentile to determine an objective for a site automatically leads to 10% of samples exceeding the values at this site**, in order that pristine sites can achieve high water quality scores. Amend the site-specific objectives manual while cross-referencing with the Index manual of the CCME.
7. **Continued refinement of the Index and its application is required through ground truthing** with expert opinions, testing data sets and reporting back, in order that site-specific water quality objectives allow the Index to agree with expert assessment.
8. **Develop a flowchart to prioritize the choice of national/provincial WQ guidelines and site-specific water quality objectives**, depending on the use. Include considerations of costs, toxicological implications, science, reporting and decision-making needs.
9. **If no site-specific water quality objectives are available, the CCME Water Quality Task Group (WQTG) and the National Guidelines and Standards Office (NGSO) of Environment Canada should be tasked with providing assistance in developing site-specific objectives.** If there are no guidelines available in Canada for the WQ variables, international guidelines should be employed if they exist. If none exist, then do not use the variable or do not use the WQI. The CCME WQTG and the NGSO should also provide guidance on which international guideline processes are most in tune with the CCME approach.
10. It is necessary to assume people will use the tool properly and honestly, taking advantage of the guidance available. **Training and guidance should be provided in the CCME WQI manual.** Promote the proper use of the WQI by providing good guidance on choosing the number and type of variables, and guidelines (site-specific or otherwise) for particular uses of the WQI.
11. **Define the scope of “water quality”** as it relates to the Water Quality Index.
12. **Develop a framework for which data should be collected nationally/regionally.** This should be categorized by beneficial use and stressor (human activity). Under each look at the spatial scale (e.g. eco-districts, watersheds, land-use), number of stations needed, and locations.
13. Within this framework, develop **a minimum standard for monitoring programs** that takes into account current monitoring programs and logistical challenges in some areas. This would provide base data to ensure Canada-wide and regional roll-ups of the WQI can be done.
14. Provide more **guidance on the use of sub-indices** for local and regional reporting where specific indices for a particular sector (e.g., agriculture) may be desired.

15. Encourage a **Canada-wide distributed database and an inter-operable open data system** (e.g. CISE Water) to support the development and calculation of the WQI both nationally and regionally.
16. **Communications Strategy** - Before releasing subsequent WQI reports, a Communication Strategy should be developed. There should be minimum contextual requirements for reporting (e.g., statement of input variables and guidelines applied).
17. **“Water Quality 101”** – Future WQI reports should include a description of the WQI (a general version for general audiences and a more technical version for specialists).
18. **“Water for Dummies”** - Future WQI reports should include basic information on water to provide context for the reader.
19. **Interpreting the Data** – Future WQI reports should include text that explains the results of the WQI, both for each site assessed, and for roll-ups (depending on the geographic level on which the report is focused).
20. **Context/Disclaimer** - A prominent context/disclaimer should be included with every WQI report.
21. **Demonstrations and testing of the WQI, similar to the Atlantic Canada Pilot, should be explored in other regions**, such as the Northern Territories and the Prairie Provinces, on other spatial scales (e.g. national, regional, watersheds, etc), and on issue-based approaches (e.g. sector).
22. The success of the WQI is dependent on the availability of good data. The trend to greater transparency and access to data by jurisdictions must be promoted and encouraged wherever possible. In order to maintain momentum in this regard, it is recommended that **a workshop on the issue of data access be held within 6 months**. The goals of the workshop should be to promote the reporting of the data in general and the WQI in particular.
23. **The Proceedings of this workshop should reinforce that:**
 - The WQI is a valuable tool for communicating information;
 - The WQI still needs reinforcement and guidance on specific uses;
 - This group of practitioners commits to implementing an action plan to ensure that the Index is ready for widespread adoption within one year.
24. **The CCME should commit to continuing in a leadership role in the development and application of the WQI**. This is important as other groups may wish to adopt the tool and they may not have as deep an understanding of its value and limitations.

25. **“The Index itself needs to be understood within the proper context of the whole chain of water quality information – from monitoring to data management and access to reporting.”**
26. **More attention, effort and funding** must be made available to ensure that the data necessary to feed the Index and for reporting is generated.
27. The CCME **should explore the feasibility of a national water quality monitoring agreement**, which would cover water quality monitoring from design to reporting using existing examples such as the national multi-lateral air quality monitoring agreements.
28. **Use UNEP’s GEM (Global Environmental Monitoring System) water sites for WQI data.** These need to be increased and using them for WQI data collection would be cost-efficient.
29. A specific **methodology for trend analysis** is needed.
30. Methods are needed that will **allow the Index to accommodate qualitative standards.**

3.2 GROUP 1: KEY INPUTS FOR INDEX CALCULATION

Group 1 focused on the key inputs for calculation of the WQI. Specifically the group discussed the selection and number of water quality variables, the frequency of sampling, and the period of time selected for Index calculation.

Strengths and Benefits of the WQI in Terms of Inputs

- Flexibility: the Index is adaptable to different jurisdictional needs and their data availability, and new variables can be added to the calculation if a change in that indicator is of interest
- It has been used effectively to measure change over time and space
- It reflects input from experts
- It can be calculated on parameter groupings
- It simplifies statistically complex data

Weaknesses of the WQI

- Factor 1 (F1; scope, number of variables) can saturate very quickly and has too much weight in the WQI calculation if there are too few variables or many co-varying parameters.
- If co-varying parameters are included within a class (e.g. total phosphorus, ortho-P) then it can overweight the Index
- Flexibility vs. potential bias – the result of the Index can be made good or bad, depending on which variables are fed into the calculation and whether appropriate guidelines/objectives are used
- Lack of guidance on which variables to use (where, when and why)

Recommendations for Improvement

Topic: Selection of Water Quality Parameters	
Recommendation #1	<p>Establish a core set of variables that can be used to calculate the WQI for the purposes of reporting at the national and regional levels.</p> <p>The following is a <i>recommended</i> set of core variables to be used when little is known about the state of water quality and the influence of local natural and anthropogenic stressors at particular sites. It is recognized that it may not be possible or appropriate to use every candidate core variable in all cases. At this point, the list is conceptual and must still be evaluated. Users of the index are encouraged to customize this list whenever possible. Note that this set is not intended as a “core” to be applied at all sites; rather, experts felt that these variables would give a first estimate of water quality.</p> <p>Variables: total phosphorus; un-ionized ammonia; nitrate-nitrite; chloride (or appropriate reactive chlorine species); plus pH, temperature and dissolved organic carbon as additional information.</p>
Considerations	<ul style="list-style-type: none"> • Pre-workshop questionnaire identified the need to provide guidance on which basic variables should be included. • Are data available? • Are water quality objectives/guidelines available? (Would be desirable to have existing objectives/guidelines, but candidate variables should not be ruled out if they are important for reporting at the national/regional levels) • Water body type (Core variables should focus on fresh water and should address different water body types, i.e. lakes, rivers, streams, etc.) • State of analytical chemistry?
Action Steps	<ul style="list-style-type: none"> • Review existing lists of core indicators (EMAN; Oregon; USGS; U.S. Index of Watershed Indicators, etc. and the results of current WQI studies, e.g., the Atlantic WQI study) as an input to establishing a set of core variables. • Examine the proposed list in light of current programs/projects to see if the candidate set would be applicable and implementable in various jurisdictions. • Explore the potential inclusion of Cl as a core variable (recognizing that there is no existing objective/guideline) in light of its importance as an indicator of urbanization, and the fact that it addresses an important emerging trend. • Ensure that proposed core variables are closely linked to monitoring and data collection efforts. • After completing the above steps, consult with water quality experts on the proposed set of core variables. • Consider establishing a national fund to test and implement the core set. • Once the core set of variables has been established, set up a process to ensure regular review and fine-tuning, with the potential to add or delete variables as new trends emerge.

Topic: Selection of Water Quality Parameters (cont'd)	
Recommendation #2	Recognizing that in order to address local conditions, additional, site-specific variables will be needed to calculate the WQI, consistent, detailed guidance should be provided to Index practitioners regarding the selection and use of additional variables. Overall, it is recommended including only relevant variables, which could include those central variables plus, for example, metals and/or pesticides and/or nutrients.
Considerations	<ul style="list-style-type: none"> • All relevant variables should be included in the calculation of the index. • Avoid “loading” the index with a number of covariates. • Consideration should be given to the beneficial uses of the water body(ies) of concern. • Consider using a sub-index approach as the cornerstone for detailed guidance for Index users for more localized reporting. Review the CCME “15 threats” as part of establishing candidate sub-index categories for local reporting. Sub-index categories could include: <p style="margin-left: 40px;">Pesticides Metals Organics</p> <p style="margin-left: 40px;">Other Site Specific Issues (e.g., domestic substances; ions; nutrients)</p> <p>The “donut” diagram opposite shows the relationship between the recommended core variables and the additional variables that should be evaluated and included if appropriate (Figure 1).</p>
Action Steps	<ul style="list-style-type: none"> • Develop a “decision tree” or flowchart, incorporating main considerations and decision nodes, to help in the variable selection process. • Such a tool could be applied to sub-indices once this approach has been confirmed and fleshed out. • Key items for inclusion in the guidance are: <ul style="list-style-type: none"> o Discussion of relation of objectives/guidelines to exceedences; o Data availability and use; o How to address key local issues (e.g., lead in urban area) through variable selection; o Impact of geographic considerations on variable selection.

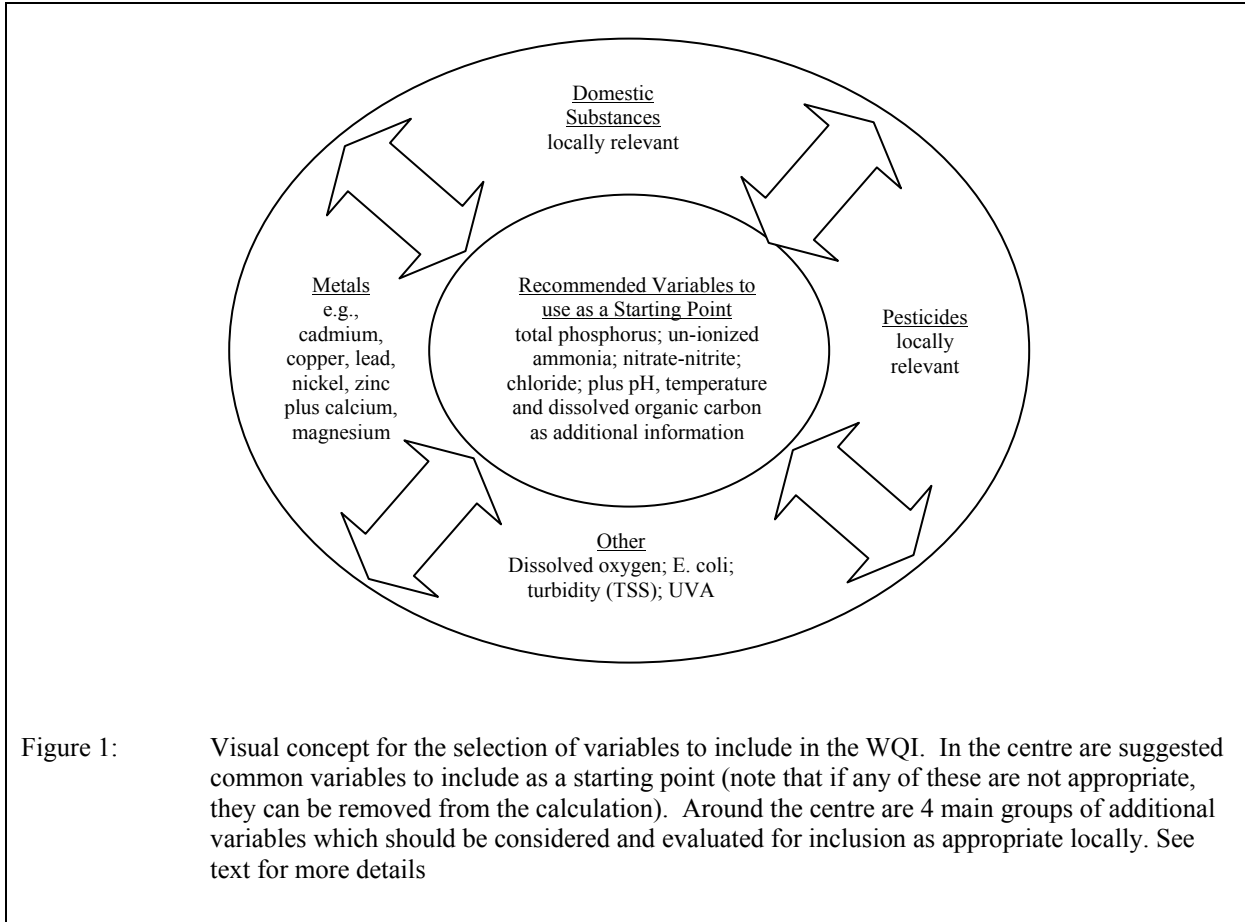


Figure 1: Visual concept for the selection of variables to include in the WQI. In the centre are suggested common variables to include as a starting point (note that if any of these are not appropriate, they can be removed from the calculation). Around the centre are 4 main groups of additional variables which should be considered and evaluated for inclusion as appropriate locally. See text for more details

Topic: Frequency of Sampling/Time Period	
Recommendation #3	At a minimum, the frequency of sampling should be four samples per year (minimum one per season). A three-year rolling average of the data should be used as a basis for calculating the Index.
Considerations	<ul style="list-style-type: none"> WQI could be calculated annually
Action Steps	<ul style="list-style-type: none"> Provide clear guidance on what to do if more data is available (i.e. more than four samples). Provide more guidance on how to deal with sampling in specific circumstances (e.g., upstream/downstream locations).
Topic: Sensitivity Analysis	
Recommendation #4	Develop and implement a sensitivity analysis to evaluate key inputs to the WQI
Considerations	<ul style="list-style-type: none"> Analyze the number of exceedances vis a vis the number of variables used. Analyze to see if four samples, using a three-year running average, is sufficient. Verify the magnitude of the “dampening function” in relation to the core variables. Consider if F1 is putting undue influence on the Index, once core variables have been identified. Examine the minimum and maximum number of variables to be used.

Other recommendations and actions raised by the group related to national monitoring sites and site-specific objectives have been integrated into similar recommendations made by other groups:

- Review the 90th percentile for reference sites using standard deviation and other appropriate methods (e.g., two times standard deviation, background concentration).
- Examine existing work/examples (e.g., MacKenzie River case study) for guidance on developing and using site-specific objectives.

3.3 GROUP 2: USE OF OBJECTIVES AND GUIDELINES

Group 2 explored the issues and opportunities relating to the use of water quality objectives and guidelines in the WQI. Water quality objectives and guidelines are a critical input to the WQI, providing the benchmarks against which water quality is assessed using the Index. The group explored the possibilities of using consistent guidelines across Canada, and whether this would be appropriate for site-specific or regional analyses.

Strengths of Index in Terms of Objectives and Guidelines

- Tool to reflect quality of water at a site
- Management tool for man-made influences

Weaknesses and Challenges of the Index

- There appears to be confusion on the purpose of the Index
- Using the 90th percentile at a pristine or reference site to determine an objective leads automatically to 10% of the samples exceeding the values at this site, weighting the F1 value.
- WQI is open to bias
- Site-specific water quality objectives may not be available and may take a lot of time and effort to obtain

Recommendations

Topic: Clarity of Index Purpose	
Recommendation #1	Clarify the purpose of the WQI in order to provide guidance and support on the selection of thresholds.
Action Steps	<ul style="list-style-type: none"> • Ensure next version (1.1) explicitly states its purpose prominently. • Clarify for different uses. <p>For example, if the Index is being used to assess drinking water quality, then drinking water quality Guidelines (CCME) must be used. If the Index is used to assess the quality of water for aquatic life, then the appropriate thresholds should be used.</p>
Topic: Site-specific Objectives	
Recommendation #2	Resolve the issue that using the 90th percentile to determine an objective for a site automatically leads to 10% of samples exceeding the values at this site, in order that pristine sites can achieve high water quality scores. Put in amendments to or revise the site-specific objectives manual while cross-referencing with the Index manual of the CCME.
Considerations	<p>Examples:</p> <ul style="list-style-type: none"> • Not using the 10% of the scores which are automatically out of range when the 90th percentile is used; • Adopt the mean +/- 2 standard deviations (SDs) as the objective • Parametric vs. non-parametric statistics • Application of a correction factor

	<ul style="list-style-type: none"> • The use an “IF... THEN” function in the calculator • Ranked 90th percentile (i.e., MS Excel PERCENTRANK function) produces 10% “failed tests” for all sites and all variables while Range 90th percentile (i.e., MS Excel PERCENTILE function) does not.
Action Steps	<ul style="list-style-type: none"> • Task the CCME Water Quality Task Group to amend or revise the CCME site-specific objectives manual in the context of the WQI. Draft by end of the fiscal year.
Recommendation #3	Continued refinement of the Index and its application is required through ground truthing with expert opinions and testing data sets and reporting back, in order that site-specific water quality objectives allow the Index to agree with expert assessment.
Considerations	<ul style="list-style-type: none"> • A proper index, derived from the correct variables and corrective site-specific water quality objectives will always agree with experts.
Recommendation #4	Develop a flowchart to prioritize the choice of national/provincial WQ guidelines and site-specific water quality objectives, depending on the use. Include considerations of costs, toxicological implications, science, reporting and decision-making needs.
Considerations	<p>If overall approach is consistent at a national level, Index values of different sites, derived with different site-specific objectives and variables, can be compared. Consistency needs to be achieved in:</p> <ul style="list-style-type: none"> • Threshold development • An approach to variable selection • Program monitoring design <p>Example : If an Index of 83 is calculated in a swamp, using the appropriate site-specific objectives and variables for that swamp, and another Index of 83 is calculated for a recreational lake, using entirely different but site-appropriate objectives and variables, the quality rating of the two bodies of water can be considered equal even if the water from them cannot be considered equal. One is good swamp water for aquatic life, the other is good lake water for recreation.</p> <p>If you want to assess this swamp in the context of using it as a source for salmon fishing or drinking water, then a different set of variables and guidelines will need to be used - the WQI would, and rightly so, return a low value indicating that the swamp is not suitable to salmon fishing or drinking water.</p>
Action Steps	<ul style="list-style-type: none"> • WQI Task Group to develop in 6 months.

Recommendation #5	<p>If no site-specific water quality objectives are available, the CCME Water Quality Task Group (WQTG) and the National Guidelines and Standards Office (NGSO) of Environment Canada should be tasked with providing assistance in developing site-specific objectives, through:</p> <ul style="list-style-type: none"> • Providing guidance to WQI users on how to develop site-specific objectives using, for example: <ul style="list-style-type: none"> ○ existing CCME guidance documents including background concentration procedure, particularly for naturally occurring substances ○ 90th percentile of reference sites ○ 2 times standard deviation ○ or other appropriate methods • National monitoring framework • Providing ongoing assistance and expertise • Exploring the capacity for the development of site specific objectives across jurisdictions. <p>If there are no guidelines available in Canada for the WQ variables, international guidelines should be employed if they exist. If none exist, then do not use the variable or do not use the WQI. The CCME WQTG and the NGSO should also provide guidance on which international guideline processes are most in tune with the CCME approach</p>
Considerations	<p>Examples:</p> <ul style="list-style-type: none"> • Where no local or site specific objectives exist, it may not be appropriate to use national guidelines or objectives (from Group #1) • Examine existing work/examples (e.g., MacKenzie River Case Study) for guidance on developing and using site-specific objectives
Topic: Removal of Index bias	
Recommendation #6	<p>It is necessary to assume people will use the tool properly and honestly, taking advantage of the guidance available. Training and guidance should be provided in the CCME WQI manual. Promote the proper use of the WQI by providing good guidance on choosing the number and type of variables, and guidelines (site-specific or otherwise) for particular uses of the WQI.</p>
Action Steps	<ul style="list-style-type: none"> • Put guidance in the Index documentation as well as the guidance manual.

3.4 GROUP 3: MONITORING AND DATA

Group 3 addressed how to deal with monitoring related issues and the WQI, including what data is available and what is not, inconsistencies, analytical advancements and more. The group discussed and provided recommendations on how to improve the WQI as well as monitoring and data to support the index, building on current jurisdictional water quality monitoring programs.

Strengths and Benefits of the WQI in terms of Monitoring and Data

In general, the group felt that the WQI is a good tool for communicating out complex information on water quality, and provides a strong connection between monitoring and reporting. The group felt that the Index:

- Helps simplify complex data
- Is easy to calculate
- Is flexible – it can accommodate regional variations, and still use important variables
- Provides a plain language report card
- Could encourage consistency in monitoring programs
- Provides a link between what we're doing (in monitoring) and why
- Highlights the value of monitoring and water quality in general from the perspective of the public, which could lead to increased funding for more monitoring programs
- Has the potential to “personalize” water quality for the public. (The WQI could do for water what the air quality index has done for air)
- Encourages the use of data in both analysis and reporting. Currently a lot of data is collected, yet it sits unanalyzed in databases because of a lack of tools to report out on this information
- Improves the current “data rich/information poor” situation
- Can confirm and/or remove current misinformation or misrepresentations, including traditional knowledge and public perceptions

Challenges and Weaknesses of the current WQI

Challenges and weaknesses of the current WQI were noted in the following categories:

- Current data sets:
 - There is a lack of data in current programs, specifically organics (pollutants, pesticides, PCBs, organophosphates, etc. – these substances are expensive to analyze)
 - Need for quality assured data
- Current monitoring programs:
 - Lack of site-specific objectives
 - Lack of a match between analytical capabilities and WQI guidelines
 - Lack of consistency in analytical methods across the country
 - Lack of consistency in use of the WQI (what variables, what objectives)

- Lack of representativeness in geographical coverage. Currently, monitoring is focused on populated areas
- Monitoring programs are currently not designed for reporting out nationally. Need to rethink the way monitoring programs are currently designed and reported upon
- Keeping monitoring programs current with new technology
- Lack of staff and resources
- The WQI:
 - There is no link with biological indicators/data
 - There is no clear definition of water quality or of the questions being asked for the WQI – monitoring should reflect the questions being asked (e.g., by the public)
 - Comparing provinces with respect to water is a challenge - finding multi-jurisdictional value, and communicating local information farther than locally
 - Making a system that can operate at multiple geographic scales, from local to national
 - Setting priorities locally, provincially, nationally
 - No guidance on protocols for sub-indices
 - No definition for pristine/natural levels of variables
 - Need the design of a network to report on the Index (reference vs. impacted sites)
 - Data should not be collected just to feed the Index

Recommendations for Enhancement

The Monitoring and Data breakout group produced the following five recommendations on how the WQI could be improved with respect to monitoring and data.

Topic: Lack of a ‘Starting Point’	
Recommendation #1	Define the scope of “water quality” as it relates to the Water Quality Index.
Considerations	<ul style="list-style-type: none"> • To what extent should biological aspects (e.g., biodiversity, sediment biota) be incorporated or used in conjunction with WQI? Need to address long-term planning. If biological aspects not incorporated, change WQI to “Water Chemical Index”. • Natural/pristine areas with naturally high levels of certain substances (e.g. metals) – how should these be reported, as good? • Should sediment be included? • Is the Index a tool for measuring natural change over time?, or, Should it primarily focus on the human activities that stress water quality?
Action Steps	<ul style="list-style-type: none"> • Add clarification in the WQI guidance document on what the water quality index is now.
Topic: Lack of Data, Lack of Representativeness	
Recommendation #2	Develop a framework for what data should be collected nationally/regionally. This should be categorized by beneficial use and stressor (human activity). Under each look at the spatial scale (e.g. eco-

	districts, watersheds, land-use), number of stations needed, and locations.
Considerations	<ul style="list-style-type: none"> • Questions that are being asked • Need for site-specific objectives • Extrapolations to consider spatial aggregation tool (aggregate, average), local/regional diversity • Appropriate extrapolations for WQI needed in a national roll-up • The framework could be broken down by national, regional, local and watershed levels • Address long-term monitoring plan; suggest 1 station at outlet of each basin
Topic: Lack of Consistency/Need for Quality Data	
Recommendation #3	Within this framework, develop a minimum standard for monitoring programs that takes into account current monitoring programs and logistical challenges in some areas. This would provide base data to ensure Canada-wide and regional roll-ups of the WQI can be done.
Considerations	<ul style="list-style-type: none"> • Inherent variability in water quality, particularly in lotic systems • Should include representative spatial coverage, variables and methods used, and sampling frequency • Identify a core set of national sites for calculation of the WQI (from Group #1) • Limit site-specific variables • Should have a quality assurance and quality control (QA/QC) plan or guideline to ensure high quality data • Anyone who collects data should use accredited laboratories (e.g. CAEAL) • Should include a methods dictionary for across Canada, including parameter vocabulary
Recommendation #4	Provide more guidance on the use of sub-indices for regional and local reporting as opposed to a Canada-wide set of variables (e.g. stressors and beneficial uses).
Considerations	<ul style="list-style-type: none"> • Can you use site-specific stressors of concern at a particular site in a national roll-up? Instead of the same variables at all sites? • Need for educational process to coincide with implementation of the WQI for both practitioners and the public.
Recommendation #5	Encourage a Canada-wide distributed database and an inter-operable open data system (e.g., CISE Water) to support the development and calculation of the WQI both nationally and regionally.

Other recommendations raised by the group include:

- Clearly report what the Index reflects
- Clarify the scope of the definitions in reporting
- Send 2 representatives from each breakout group to sit on the WQI Steering Committee in order to share the details of discussions in each group.

3.5 GROUP 4: REPORTING AND COMMUNICATIONS

Group 4 discussed reporting and communications of the WQI. Issues explored included key target audiences for the WQI, requirements for reporting the WQI at local, regional and national levels, and promotion of the WQI as an effective communication and reporting tool.

Strengths of the WQI in Terms of Communicating and Reporting

The group agreed that the WQI was (or had the potential to become) a good tool for communicating to the public about water quality. The attributes of the WQI that make it a good communication tool include:

- It is simple
- It is understandable
- It lends itself to graphic depictions
- It can send a clear message
- It is scientifically credible
- It allows a consistent approach to reporting at various scales
- With a consistent data base, the WQI can be “drilled down” for more detail
- It will get information on water quality out to the public
- It can have a positive feedback effect (i.e., it can encourage better/more monitoring)
- It can be used at different geographic scales and in different jurisdictions
- It can be used to compare different geographic areas (Note: this is both a strength and a weakness)
- It can be used to compare over time (Note: this is both a strength and a weakness)
- It is representative of a larger field of information and indicators
- It meets the needs and interests of the public
- It can influence decision-makers to act

Weaknesses of the WQI in Terms of Communicating and Reporting

The weaknesses identified include:

- There is the potential for others to over-interpret (or re-interpret) the WQI results
- Only provides a partial story about water quality (i.e., just examines common water chemistry stresses, not biology, sediment, or physical quality of a river)
- Provides a pressure point for managers to act (Note: this is both a strength and a weakness)
- Data may not always be recent/current
- Will need to explain the limitations of the WQI
- Only provides a snapshot in time and uses limited data
- Will be a challenge to address contradictory messages (such as fish kills or fish consumption advisories)
- Will lose some standardization as you go from local to regional to national scale
- There is a potential that the WQI will be used for measuring performance targets (Note: this is both a strength and a weakness)

Overcoming the Weaknesses of the WQI: Identifying Potential Solutions

The group discussed each of the weaknesses identified and generated potential ways of overcoming those weaknesses.

1. *Addressing the potential for over-interpretation of results*
 - Include a disclaimer that makes it clear that the WQI has been developed for a specific purpose, represents the best available knowledge of the time, is limited in its scope, etc.
 - Provide supporting information including:
 - a text explanation of the categories, including how they were developed
 - a description of how the Index was calculated, how the variables were selected, etc.
 - text on external factors (such as weather) that may have influenced results during the period
 - provide a reference or link to a technical supplement that provides more detailed background on the WQI
 - Work with the communications branch to develop backgrounders and media releases
 - Use a focus group to target messages, etc.
 - Use clear and simple messages
 - Use clean and simple graphics
 - Provide a contact person to answer questions and provide additional information
2. *Addressing providing a partial story on water quality*
 - Provide an explanation of the WQI including its limitations
 - Acknowledge attempts to develop indicators for biological system (e.g., CABIN), etc., if they are underway or being explored
 - Be clear that the WQI addresses only some key stresses relating to water chemistry and embed this message in a brief description of the pressure-state-response framework
 - If possible, include sub-indices that address other aspects of water quality
 - Provide links to resources or reports that address other aspects of water quality
3. *Addressing the pressure on managers*
 - Include in the disclaimer that the WQI is not the only driver for action
 - Explain the WQI's limitations
 - Be clear that the WQI was not intended to be a compliance monitoring or performance monitoring tool (although there is some potential for the WQI (an SOE indicator) to be used as a "final outcome" measure in a Results Management Accountability Framework)
 - Include background on "who does what" with respect to roles and responsibilities for water quality management
 - Provide an internal workshop or seminar on the WQI before releasing
 - Prepare a response plan before releasing the WQI report

- Consider building the WQI into results management accountability framework for several programs as a pilot study
4. *Addressing data that are not current/recent*
 - Use the disclaimer and WQI explanation
 - Provide additional resources for lab capacity, data management and interpretation
 - Establish a national network of monitoring stations
 - Develop a standardized electronic data submission program
 - Sign more federal/provincial monitoring agreements
 - Encourage simultaneous reporting at the federal and provincial levels
 5. *Addressing the need to explain the WQI's limitations*
 - Use the disclaimer and WQI explanation
 - Explain the complexity of aquatic systems
 - Provide general text on water quality
 6. *Addressing the snapshot in time/limited data*
 - Provide additional responses for monitoring (e.g., to collect additional information or allow additional stations to be monitored)
 - Address in the disclaimer and WQI description
 - Provide rolling averages over 3 to 5 years
 7. *Addressing the challenge of contradictory messages*
 - Acknowledge the apparent contradiction in the text and explain why the WQI does not reflect it (i.e., stress that the WQI deals with water quality over the long term and will not/does not pick up short-term incidents or seasonality; the WQI is set up to address specific beneficial uses and is not designed to address other uses)
 - Include an explanation of the WQI
 - Refer to other initiatives that may apply (i.e., the development of biological indices that would consider episodic events such as fish kills)
 - Include a contact name for getting further information
 8. *Addressing the loss of standardization as one moves from local to regional to national applications of the WQI*
 - The group agreed that this was almost inevitable, as the variables measured and objectives will change to reflect local conditions
 - Need to stress that the “WQI uses a common approach that provides the best quality assessment for each station. This includes use of a common equation, a minimum frequency of sampling, core variables and the use of additional variables that make the most sense locally”
 - Stress the diversity of aquatic systems
 9. *Addressing the potential to use the WQI for performance targets*
 - Hold an internal seminar or workshop to provide information to managers on what the WQI is

- Include information on the lag in response time for aquatic systems and the use of the rolling average in the explanation of the WQI
- Include a response section that addresses what will be done in the wake of the report
- The group noted that this is also a strength of the WQI, in that, whether or not it is an appropriate tool for performance targets, the use of the WQI may will increase pressure for environmental actions and/or additional monitoring

Audiences

The group identified the key audiences for the WQI at four geographic scales.

Application of WQI	Key Audiences
Local	Local interest groups, ratepayers, municipalities, Conservation Authorities, industries, planners, farmers and provincial ministries
Regional/Provincial/ Territorial	Industries, water managers, larger NGOs, scientists, provincial and territorial ministries, municipalities, user groups (such as angling associations), and federal departments
National	Politicians, federal departments and agencies such as NRTEE and the Treasury Board
International	International NGOs (such as Water Resources Institute) and international agencies (such as CEC, OECD and UNEP)
All scales	Individual, students, academics, scientists and the media

Recommendations: A Tool Kit for Communicating and Reporting the WQI

The group identified 5 tools that will help to maximize the effectiveness of communicating and reporting on the WQI. Although the group did not make any recommendations on who should develop these tools, CCME was identified as a potential source for some of the generic tools, as they have already developed tools like the User's Manual to help apply the WQI.

Topic: Communicating what the WQI "is"	
Recommendation #1	Communications Strategy - Before releasing subsequent WQI reports, a Communication Strategy should be developed
Considerations	<p>The communications strategy should:</p> <ul style="list-style-type: none"> • reflect the larger water quality/water management context for the WQI • outline the purpose of the communication and the goals • identify who the key audiences are • identify key messages (which should be used consistently, whatever the format of the WQI report) • specify the mediums or formats to be used (i.e., paper plus web-based reports) • specify how often reporting will be done

Recommendation #2	Water Quality 101 – Future WQI Reports should include a description of the WQI (a general version for general audiences and a more technical version for specialists)
Considerations	<p>The Water Quality 101 should include:</p> <ul style="list-style-type: none"> • the rationale and purpose of the WQI • how the WQI is calculated • carefully crafted text that explains what the categories mean (i.e., excellent, good, etc.) • the focus of the Index (e.g., basic water chemistry) • key characteristics of the WQI (e.g., the common approach, core variables and minimum sampling frequencies, use of local variables and objectives, use of a rolling average) • the concept of beneficial uses • the limitations of the WQI <p>Note: the current CCME material on the WQI should serve as a starting point for this work</p>
Topic: Communicating what the WQI Means	
Recommendation #3	Water for Dummies - Future WQI Reports should include basic information on water to provide context for the reader.
Considerations	<p>This should provide information on:</p> <ul style="list-style-type: none"> • basic hydrology • the complexity of aquatic systems • the response lag between actions and responses • the factors (natural and human) that affect water quality • the major categories of variables (e.g., nutrients, metals, etc.) • basic roles and responsibilities for water management (“who does what”) <p>Note: This should be very short (2-3 pages at most – one paragraph per consideration)</p>
Recommendation #4	Interpreting the Data – Future WQI Reports should include text that explains the results of WQI, both for each site assessed, and for roll-ups, (depending on the geographic level on which the report is focused).
Considerations	<p>The text should be aimed at a general audience and should include:</p> <ul style="list-style-type: none"> • what variables are driving the Index; • observations on the results; • an explanation of what the results mean; • observations on trends, where possible; • any responses that have been developed (e.g., “because of the poor WQI, additional upgrades to the sewage treatment plant have been fast-tracked”); • key reports, resources or technical backgrounders that can provide additional information about the water quality at that site; and • a contact person for addition information. <p>The amount of rationalizing in the text should be kept to a minimum. (e.g., “Although the WQI scores are low, water quality in the ____ River is actually quite good because of”).</p>

Recommendation #5	Context/Disclaimer - A prominent context/disclaimer should be included with every WQI Report.
	<p>Such a context/disclaimer should include:</p> <ul style="list-style-type: none"> • why the report was developed; • the purpose of the report; • who developed the report; • that the report represents the best understanding of conditions at the time; and • that the WQI is intended to be a tool for communicating about basic ambient water quality, not a tool for monitoring compliance or performance

Other recommendations the group raised include:

- Need to develop a clear and consistent understanding on the purpose of the WQI. Is it designed to inform the public? Is it designed to inform the public and promote action?

3.6 GROUP 5: FUTURE USES OF THE INDEX

Group 5 discussed the possibilities of adapting the WQI for a variety of different applications, including those beyond reporting. Topics included the use of the WQI as part of a series of indices, trend analysis and performance tracking.

Future Uses of the Index

The group agreed that:

- It is appropriate and feasible to adapt the WQI to enable reporting by sectoral use (e.g. mining)
- There is potential to adapt the WQI to enable trend analysis. There is also potential to use the Index for documentation of baseline or reference conditions.
- There is potential for applications of the WQI beyond reporting and communication (e.g. performance indicators)
- There is potential to include the WQI in a series of various indices, such as aquatic life, drinking water, agricultural land use, etc. to give an overall picture of environmental sustainability

Long-term Feasibility of the Index

The following points were raised for what is needed to enhance the long-term feasibility of the Index:

- More applications as examples of its use (e.g., case studies) are needed. The more the WQI is used, the better it will become and the more it will become known.
- It is important to make sure that applications are communicated correctly – that it is understood that the WQI is a “work in progress”.

- More transparency and access to water quality data is required – this is already a trend, but it should be encouraged
- CCME must make improvements to the Index and its guidance support documents within one year in order to make sure that we are ready for its widespread adoption.
- The promotion of the Index at this point in time, and the commitment to its use, is an exercise in leadership by the CCME and the attendees at this Workshop.
- The WQI itself needs to be understood within the proper context of the whole chain of water quality information – from monitoring to data management and access to reporting.
- We need marketing and promotional tools to sell the WQI to others who will use it.
- More resources and funding are required for data collection.
- A national water quality monitoring agreement, which would cover water-quality monitoring from the design of the program to reporting, is needed to ensure that the necessary data is collected and made available to users.
- CISE Water will use the WQI as a principal, web-based tool.

Recommendations for Improvement

Looking at the above needs or requirements for long-term sustainability of the WQI, the group developed 8 recommendations for the enhancement of the Index.

Topic: Testing the WQI	
Recommendation #1	Demonstrations and testing of the WQI, similar to the Atlantic Canada Pilot, should be explored in other regions, such as the Northern Territories and the Prairie Provinces, on other spatial scales (e.g. national, regional, watersheds, etc), and on issue-based approaches (e.g. sectoral).
Considerations	<ul style="list-style-type: none"> • Should go to CCME and all monitoring practitioners
Action Steps	<ul style="list-style-type: none"> • Environment Canada will send out an email within a few weeks requesting that practitioners identify potential user groups and promote the WQI.
Topic: Data	
Recommendation #2	The success of the WQI is dependent on the availability of good data. The trend to greater transparency and access to data by jurisdictions must be promoted and encouraged wherever possible. In order to maintain momentum in this regard, it is recommended that a workshop on the issue of data access be held within 6 months. The goals of the workshop should be to promote the reporting of the data in general and the WQI in particular.
Topic: Future of the WQI	
Recommendation #3	The Proceedings of this workshop should reinforce that: <ul style="list-style-type: none"> • The WQI is a valuable tool for communicating information; • The WQI still needs reinforcement and guidance on specific uses; • This group of practitioners commits to implementing an action plan to ensure that the Index is ready for widespread adoption within one year.
Recommendation #4	The CCME commit to continuing in a leadership role in the development and in the application of the WQI. This is important as other groups may

	wish to adopt the tool and they may not have as deep an understanding of its value and limitations.
Recommendation #5	The following statement should be included in the proceedings as a principle and is directed to all involved in the WQI: “The Index itself needs to be understood within the proper context of the whole chain of water quality information – from monitoring to data management and access to reporting.”
Recommendation #6	More attention, effort and funding must be made available to ensure that the data necessary to feed the Index and for reporting is generated.
Recommendation #7	The CCME should explore the feasibility of a national water quality monitoring agreement and/or framework, which would cover water quality monitoring from design to reporting using existing examples such as the national multi-lateral air quality monitoring agreements
Recommendation #8	Use UNEP’s GEMS (Global Environment Monitoring System) water sites for WQI data. These need to be increased and using them for WQI data collection would be cost-efficient.
Recommendation #9	Specific methodology for trend analysis is needed.
Recommendation #10	Methods are needed that will allow the Index to accommodate qualitative standards.

4.0 Next Steps and Path Forward

Participants met in plenary at the end of the second day of the workshop to review and discuss the recommendations made by each breakout group. In general, workshop participants were comfortable with the recommendations presented by each group (and summarized in the Executive Summary). However, several themes and discussion points were revisited during the discussion of the recommendations including:

- *Is a core set of variables desirable?* – It was noted that most of the breakout groups identified the need for core variables, including Group #1, which examined this issue in detail.
- *Should there be a commitment to refine the Index within a year timeframe?* – It was suggested that an Action Plan should be developed on a priority basis, but that addressing all of the workshop recommendations in one year may be too ambitious.
- *How and what exactly is involved in a national roll-up for reporting purposes?* – The notion of a national set of reference sites for the purposes of reporting was raised.

Participants also discussed next steps for moving forward with the WQI. Some priority actions identified in plenary include:

- Develop an Action Plan for moving forward with refining the Index – including responsibilities for each action and opportunities for partnership.
- CCME must make improvements to the Index and its guidance support documents within one year in order to make sure that we are ready for its widespread adoption.
- Amend current communication materials (e.g., the CCME website, CCME WQI fact sheets).
- Develop a communications strategy for the WQI.
- The promotion of the Index at this point in time, and the commitment to its use, is an exercise in leadership by the CCME and the attendees at this Workshop.
- Clarify the purpose and the audiences of the WQI – who is the ultimate consumer, how will it be used?
- Recognize that mutually supportive partnerships are required to enhance the Index and achieve widespread use.
- A national water quality monitoring agreement and/or framework, which would cover water quality monitoring from the design of the program to reporting, is needed to ensure that the necessary data is collected and made available to users.

The WQI Steering Committee will continue to meet to develop and implement an action plan to refine the WQI. Proceedings from the workshop will be distributed to all meeting participants and will be posted on the CCME website at www.ccme.ca.

Appendix A: Workshop Agenda

CCME National Water Quality Index Workshop

Halifax, Nova Scotia

Summary Event Schedule

Sunday 23 November 2003		
Activity	Place	Time
Registration Desk Open	Outside of Nova Scotia Ballroom A (second floor)	19:00 – 20:30
Monday 24 November 2003		
Registration Desk Open	Outside of Nova Scotia A	7:00 – 8:30 and at coffee breaks
Coffee and Juice	Nova Scotia A	8:00 – 8:30
Plenary	Nova Scotia A	8:30 – 12:00
Coffee, Juice and Snacks	Nova Scotia A	10:15 – 10:30
Lunch	Buffet Served in Nova Scotia A	12:00 – 13:15
Lunch Time Speaker		12:30 – 13:15
Charge to Breakout Sessions	Nova Scotia A	13:15- 13:30
Breakout Sessions		13:30 – 15:00
Key Inputs for Index Calculation	Nova Scotia A	
Using WQGs and WQOs	Suite 286	
Monitoring and Data	Suite 288	
Reporting and Communicating the WQI	Sir Charles Tupper (ground floor)	
Future use of the WQI	Halifax B (second floor)	
Coffee, Juice and Snacks	Served in each room	15:00 – 15:15
Breakout session con't	See room names above	15:15 – 16:15
Networking	Nova Scotia A	16:15 – 16:30
Plenary	Nova Scotia A	16:30 – 17:30
Atlantic Region WQI Steering Committee Meeting	Nova Scotia A	20:00 – 21:00
Tuesday 25 November 2003		
Registration Desk Open	Outside of Nova Scotia Room A	7:00 – 8:30 and at coffee breaks
Coffee and Juice	Nova Scotia A	8:00 – 8:30
Plenary	Nova Scotia A	8:30 – 10:00
Coffee, Juice and Snacks	Nova Scotia A	10:00 – 10:15
Charge to Breakout sessions	Nova Scotia A	10:15-10:25
Breakout sessions cont'd	See room names above	10:25 to 12:00
Lunch	Buffet Served in Nova Scotia A	12:00 – 13:00
Lunch Time Speaker		12:30 – 13:00
Plenary	Nova Scotia A	13:00 – 14:00
Coffee, Juice and Snacks/ Network Time	Nova Scotia A	14:00 – 14:30
Plenary	Nova Scotia A	14:30 – 16:45

Program
Day 1
Monday 24 November 2003

Time	Presentation Topic	Speaker
8:30	Welcome	Risa Smith, A/Director Environmental Reporting Branch, EC
8:40	Purpose of workshop Review of program logistics	Les Swain, Workshop Chair David Dilks, Lura Consulting, Workshop Facilitator
	Plenary Session I: Overview of the WQI - Where we're at	
8:50	The Water Quality Index – Its early testing, application and results	Les Swain
9:15	Reporting the CCME WQI as the proposed National Freshwater Quality Indicator	Wayne Bond Vincent Mercier
	Plenary Session II: What we have learned	
9:35	Applying the CCME WQI in Atlantic Canada: Results and lessons learned	Vincent Mercier Don Fox
10:00	Coffee, Juice and Snacks	
10:15	Taking the Canada Water Quality Index for a Test Drive	Scott Painter
10:40	Experiences with the Application of the CCMEWQI	Haseen Khan
11:05	Comparison of the CCME WQI and the Quebec IQBP	Serge Hébert
11:30	Challenges (pre-workshop study/questionnaire): What do we need to improve for regular presentation of the WQI on a national and regional basis? Issues to resolve as identified in survey of practitioners and users	Bernie Neary, Gartner Lee Ltd., Workshop Questionnaire
11:55	Summary of morning's discussions	Les Swain/David Dilks
12:00 to 13:15	Lunch	
12:30	Comparison of Canadian and French Water Quality Indices	Haseen Khan
	BREAKOUT SESSION I	

Time	Presentation Topic	Speaker
13:15	Introduction of small group discussions (plenary) Issues areas to discuss How discussions will be structured General Principles	David Dilks
13:30	Small group discussions: 1. Key Inputs to Index Calculation; 2. Using WQGs and WQOs; 3. Monitoring and Data; 4. Reporting and Communicating; 5. Future Use of the WQI Phase I: Explore Issues	Session facilitator, resource person and note taker
15:00	Coffee, Juice and Snacks	
15:15	Small group discussions cont'd Phase II: Discuss solutions, choices, for implementation	Session facilitator, resource person, and note taker
16:15	Networking	
16:30	Plenary Each sub-group reports back on key aspects of issues and possible solutions (10 minutes/sub-group)	Session facilitator from each sub-group
17:20	Plenary summary of day 1	David Dilks
17:30	Ajourn	

Day 2
Tuesday 25 November 2003

Time	Presentation Topic	Speaker
8:30	Introductory remarks	Les Swain, Workshop Chair
8:35	Review of day 1, key findings and discussion	David Dilks
	Plenary session III: Reporting Using the WQI and Monitoring Implications	
8:50	Water Quality Monitoring in Canada: Where are we?	Janine Murray
9:15	Application of CCME Water Quality Index to Various Sites in the Mackenzie River Basin	Doug Halliwell
9:35	Reporting on the WQI through CISE: Newfoundland Pilot Study	Geoff Howell Haseen Khan
10:00	Coffee, Juice and Snacks	
	BREAKOUT SESSION II	
10:15	Charge to breakout groups for next session	Workshop Facilitator
10:25	Small group discussions cont'd from day 1 Phase III: Select solutions, develop plan for issue area to support regular national / regional reporting of WQI	Session facilitator, resource person, and note taker
12:00 – 13:00	Lunch	
12:30 – 13:00	Application of the Water Quality Index to Sediment of the Lower Great Lakes	Scott Painter
	Plenary session IV: Moving the WQI Forward	
13:00	Report from six small group discussions on identified solutions and plan to support WQI reporting, national and regional (approx. 10mins/sub-group)	Session facilitator from each sub-group
14:00	Coffee / Network (time for workshop facilitators to compile the draft recommendations)	
14:30	Draft recommendations to move forward on reporting on the WQI nationally and regionally	Les Swain to present based on compilation by workshop facilitators and note takers
15:00	Plenary discussion to review, revise, accept recommendations as a plan of action	David Dilks to animate
16:30	Closing remarks on plan of action	Les Swain and David Dilks
16:45	Adjourn	

Appendix B: List of Participants

Michel Arès*

ECONOVA
Shawinigan, Québec

Pierre-Yves Caux

Environment Canada
Science Program Co-ordination
Gatineau, Québec

Nelda Craig

New Brunswick Environment and Local
Government
Sciences and Reporting
Fredericton, New Brunswick

Andrea Czarnecki

Indian and Northern Affairs
Water Resources Division
Gatineau, Québec

Jean-Guy Deveau

Environment Canada
Environmental Conservation
Dartmouth, Nova Scotia

Don Fox

New Brunswick Environment and Local
Government
Water Quality Section
Fredericton, New Brunswick

Nancy Glozier

Environment Canada
PNR Wildlife Research Centre
Saskatoon, Saskatchewan

Doug Halliwell

Environment Canada
Northern Section
Yellowknife, Northwest Territories

Wayne Bond

Environment Canada
National Indicators and Reporting Office
Gatineau, Québec

John Clarke

Environment Canada
Environmental Protection Branch
Dartmouth, Nova Scotia

Chris Cuddy

Indian and Northern Affairs
Land and Water Management Division
Gatineau, Québec

Sarah Depoe

Alberta Agriculture, Food, and Rural
Development
Conservation and Development Branch
Edmonton, Alberta

Monique Dubé

Environment Canada
Cumulative Impacts on Aquatic Biodiversity
Saskatoon, Saskatchewan

Ron Gauthier*

Environment Canada
Integrated Environmental Applications
Branch
Gatineau, Québec

Sarah Hall

Environment Canada
Integration and Interpretation Section
Dartmouth, Nova Scotia

Bill Hart

Dalhousie University
Center for Water Resources Studies
Halifax, Nova Scotia

Serge Hébert

Ministère de l'Environnement du Québec
Direction du Suivi de l'état de
l'environnement
Quebec City, Québec

Geoff Howell

Environment Canada
Integrated Environmental Applications
Gatineau, Québec

Chris Jones

Ontario Ministry of the Environment
Environmental Monitoring and Reporting
Branch
Dorset, Ontario

Haseen Khan

Newfoundland and Labrador Department of
Environment
St. John's, Newfoundland

Ashok Lumb

Environment Canada
Ecological Monitoring and Assessment
Network
Burlington, Ontario

Beverly McNaughton

Environment Canada
Aquatic Science
Vancouver, B.C.

Christina Mosher

Nova Scotia Department of Environment and
Labour
Water and Wastewater Branch
Halifax, Nova Scotia

Bernie Neary

Gartner Lee Ltd.
Ecology Group
Markham, Ontario

Bruce Raymond

P.E.I. Fisheries, Aquaculture and
Environment
Watershed Management
Charlottetown, P.E.I.

Bruce Holliday

Environment Canada
Environmental Conservation Branch
Regina, Saskatchewan

Francis Jackson

Indian and Northern Affairs
Water Resources Division
Yellowknife, Northwest Territories

Rob Kent

Environment Canada
Water Quality Monitoring Branch
Gatineau, Québec

Chris Lochner*

Environment Canada
Water Quality Monitoring Branch
Gatineau, Québec

Darcy McDonald

Alberta Environment
Environmental Monitoring and Evaluation
Branch
Edmonton, Alberta

Vincent Mercier

Environment Canada
National Indicators and Reporting Office
Moncton, New Brunswick

Janine Murray

Environment Canada
Water Quality Monitoring Branch
Gatineau, Québec

Scott Painter

Environment Canada
Ecosystem Health
Burlington, Ontario

Don Renaud

Environment Canada
Water Priorities Branch
Gatineau, Québec

Angie Richard[†]
Environment Canada
Water Priorities and Co-ordination Branch
Gatineau, Québec

Susan Roe
Environment Canada
National Guidelines and Standards Office
Gatineau, Québec

Andrea Ryan
Environment Canada
Aquatic Science
Vancouver, B.C.

Tribeni Sharma
St. Francis Xavier University
Department of Earth Sciences
Antigonish, Nova Scotia

Paula Spencer
Indian and Northern Affairs
South Mackenzie District
Yellowknife, Northwest Territories

Les Swain
B.C. Ministry of Water, Land and Air
Protection
Water and Air Monitoring and Reporting
Section
Victoria, British Columbia

Doug Trant
Statistics Canada
Spatial Analysis Section
Ottawa, Ontario

* attended plenary sessions only

[†] administrative support

[‡] note taker

Carmella Robertson[‡]
Nova Scotia Department of Environment and
Labour
Water and Wastewater Branch
Halifax, Nova Scotia

Bernard Rondeau
Environment Canada
Programme Suivi de l'état du Saint-Laurent
Montreal, Quebec

Uwe Schneider
Environment Canada
National Guidelines and Standards Office
Gatineau, Québec

Risa Smith
Environment Canada
Environmental Reporting Branch
Gatineau, Québec

Doug Spry
Environment Canada
National Guidelines and Standards Office
Gatineau, Quebec

Darrell Taylor
Nova Scotia Department of Environment and
Labour
Water and Wastewater Branch
Halifax, Nova Scotia

Taina Tuominen
Environment Canada
Aquatic Science
Vancouver, British Columbia

Facilitation Team

Lead Facilitator: Dave Dilks, Lura Consulting

Breakout Session Facilitators:

- Group 1: Dave Dilks, Lura Consulting
- Group 2: Ken Donnelly, Lura Consulting
- Group 3: Sandra Znajda, Lura Consulting
- Group 4: Joanna Kidd, Lura Consulting
- Group 5: Glen Munroe, Lura Consulting

Appendix C: Presentation Abstracts

1. THE WATER QUALITY INDEX- ITS EARLY TESTING, APPLICATION AND RESULTS.

AUTHOR: LES SWAIN

B.C. Ministry of Water, Land and Air Protection

ABSTRACT:

The CCME water quality index was developed by a sub-committee of the CCME water quality guidelines task group in order to convey complex scientific information to Canadians about the state of their waters. The CCME index was based in large part on a similar index developed by the B.C. ministry of environment in the mid-1990's. The B.C. index was modified in part using information subsequently developed through the ministry of environment in Alberta. This paper will discuss the development of the B.C. Index, the process of communicating this development work to its CCME partners, the types of reports developed in B.C. And other partners with the index as a basis, and the final development of the CCME index.

2. REPORTING ON THE CCME WATER QUALITY INDEX AS THE PROPOSED NATIONAL FRESHWATER QUALITY INDICATOR

AUTHORS: WAYNE BOND¹ AND VINCENT MERCIER²

¹National Indicators and Reporting Office, Environment Canada Place Vincent Massey, 9th Floor, Gatineau, Quebec, K1A 0H3; National Indicators and Reporting Office, ²Environment Canada Corner of University and Morton Ave, Moncton, NB, E3B 5H1

ABSTRACT:

In May 2003, the National Round Table on the Environment and the Economy (NRTEE) proposed the National Freshwater Quality Indicator, based on applications of the CCME Water Quality Index (WQI), as part of a set of six recommended Environment and Sustainable Development Indicators (ESDI) to be reported on a nationwide basis. It was the first time that the CCME WQI had been reported nationally, even on a preliminary basis. Few in number, technically robust, credible and easy to understand, the ESDI indicators were selected by NRTEE after an extensive multi-stakeholder process, and are proposed to be reported annually along with the national economic indicators as part of the federal budget statement.

Concerning this first national roll-up of water quality using applications of the CCME WQI and Quebec's IQBP*, this presentation describes the methods used, the results reported, and the rationale for the national use of the Index. It then discusses the challenges faced, and the kinds of improvements that will be needed if the WQI is to be reported regularly at a national and regional level. Finally, it outlines the opportunities potentially available for the WQI to be communicated to Canadians at the national level on an ongoing basis as part of the small set of Environment and Sustainable Development Indicators used by the Minister of Finance, and through other venues.

** Indice de la qualité bactériologique et physico-chimique*

PARTNERS AND CONTRIBUTORS:

Alberta Environment

Dr. Pierre Yves Caux, formerly National Guidelines and Standards Office, EC

Dr. Don Fox, NB Department of Environment and Local Government

Doug Halliwell, Prairie and Northern Region, EC

Serge Hébert, Environnement Québec

Murray Hilderman, Saskatchewan Environment

Rob Kent, National Water Monitoring Office, EC

Dr. Haseen Khan, NL Department of the Environment

Ashok Lumb, EMAN Coordinating Office, EC

Dr. Scott Painter, National Water Research Institute, EC

Bruce Raymond, PEI Department of Fisheries, Aquaculture and the Environment

Dr. Risa Smith, Environmental Reporting Branch, EC

François Soulard, Environmental Accounts and Statistics, Statistics Canada

Les Swain, BC Ministry of Water, Land and Air Protection

Darrell Taylor, NS Department of Environment and Labour

Dwight Williamson, Manitoba Conservation

3. APPLYING THE CCME WATER QUALITY INDEX IN ATLANTIC CANADA AND LESSONS LEARNED

AUTHORS: VINCENT MERCIER¹ AND DON FOX²

¹National Indicators and Reporting Office, Environment Canada Corner of University and Morton Ave. Moncton, NB, E1A 3E9; ²Sciences and Reporting Branch NB Department of Environment and Local Government Marysville Place, P.O. Box 6000 Fredericton, NB, E3B 5H1

ABSTRACT:

This presentation will focus on providing a summary of the main issues, areas of divergence, and major results of the Atlantic Pilot Project relevant to implementing the CCME WQI nationally, and within individual jurisdictions.

The Atlantic Pilot Project aimed to test and fine-tune the application of the CCME WQI for the existing monitoring, water quality issues and natural conditions found in the four Atlantic Provinces. Equally important to the project was that it provided a small-scale test of applying the index in a multi-jurisdictional setting – each jurisdiction having a unique approach to water resources management, releasing water quality information, and philosophy with regards to applying the index. Twenty-five sites were selected (including rivers, streams, estuaries and a lake) in watersheds considered to be pristine, those potentially affected by various human activities (e.g., agriculture, urban development, forestry, and industry), and those having typical features for the region (e.g., highly coloured). The project identified gaps in monitoring (e.g. frequency, detection limits, scope), needs for guideline development (e.g. site-specific objectives), and some biases or limitations of the index. In addition, discussions throughout the project revealed divergent views on what the index should be indicating, and consequently, the approach (or decisional process) used to apply it. It also provided recommendations to improve application of the index in each province and, along with other initiatives (e.g. Newfoundland and CISE pilot study), brought us one step closer to regular water quality reporting in the Atlantic Region.

Partners: Wayne Bond, National Indicators and Reporting Office, Environment Canada
Dr. Pierre-Yves Caux, National Guidelines and Standards Office, Environment Canada
Dr. Don Fox, NB Department of Environment and Local Government
Dr. Haseen Khan, NL Department of Environment,
Daniel Léger, Consultant
Vincent Mercier, National Indicators and Reporting Office, Environment Canada
Dr. Tom Pollock, Environmental Conservation Branch, Environment Canada
Bruce Raymond, PEI Department of Fisheries, Aquaculture and Environment
Darrell Taylor, NS Department of Environment and Labour

4. TAKING THE CANADA WATER QUALITY INDEX FOR A TEST DRIVE.

AUTHORS: SCOTT PAINTER AND JASMINE WALTHO

Environment Canada, PO Box 5050, Burlington, ON, L7R 4A6

ABSTRACT:

The Canadian Water Quality Index provides a new tool for water quality monitoring managers to communicate their results. However, as with any new tool, its application to existing programs and data needs to be evaluated. We assessed the sensitivity of the CWQI score to variation resulting from selection of guidelines, selection of variables, time period and sampling design. Our impressions lead us to conclude that application of the CWQI within an existing program must be considered carefully to ensure that the temporal representation of the environmental condition is reasonable. Meanwhile, application across programs requires consideration of both temporal richness but also the selection of variables.

PARTNERS: Duncan Boyd and Aaron Todd, Ontario Ministry of Environment.

5. EXPERIENCES WITH APPLICATION OF THE CCME WATER QUALITY INDEX

AUTHORS: HASEEN KHAN AND AMIR ALI KHAN

Hydrologic Modelling Section, Newfoundland and Labrador Department of Environment

ABSTRACT:

The index value categorization schema presented in the CCME WQI was changed for two applications of the CCME WQI in the province of Newfoundland and Labrador.

The first application was the use of the CCME WQI to communicate the results of the province's drinking water quality monitoring program. In a pilot study the Newfoundland and Labrador Department of Environment tested the CWQI on selected provincial drinking water quality data sets. The resulting CWQI rankings were compared against expert opinion on each particular water body. The results indicated that the CWQI would be an appropriate tool for the interpretation and dissemination of drinking water quality data but that there was a need to modify the existing CCME CWQI index value categorization schema to better reflect expert opinion. The schema was changed through a process of adjusting the rankings to reflect expert opinion and by introducing a "Very Good" category. A second field scale testing was conducted to identify issues associated with the index value categorization schema. The presentation will discuss the methodology followed, the issues raised and the path forward.

The second application was the use of the CCME WQI to rank water bodies as the potential drinking water supplies. For this an attempt was made to rank the water bodies using an index value categorization schema based on statistical relative ranking. This approach to index value categorization would be useful for applications that would benefit from a categorization scheme that is independent of subjectiveness or where expert opinion is not available.

6. COMPARISON OF THE CCME WATER QUALITY INDEX AND THE QUEBEC IQBP

AUTHOR: SERGE HÉBERT

State of the Environment Branch, Québec Ministry of the Environment

ABSTRACT:

The State of the Environment Branch of the Québec Ministry of the Environment has measured the degree of agreement between the CCME WQI and the Québec IQBP to evaluate its possible use for water quality reporting on a local, regional and national scale.

Tree sets of water quality objectives have been used to compare the indices at 133 sampling sites located in rivers and 31 sampling sites located along the St. Lawrence River. At best, there is agreement between the indices for 60 % of the sampling sites only. On the one hand, the WQI shows a lack of sensitivity and scores too high at stations where only one variable exceeds the water quality objective with a high frequency and large amplitude of exceedences. On the other hand, the WQI shows too much sensitivity and scores too low when a single sample shows exceedences for the majority of the analyzed variables. The WQI does not reflect our perception of water quality at 40 % of our sampling sites. The water quality assessments made with the IQBP and the CCME WQI are not comparable and cannot be used together to produce a national picture. The WQI could possibly be improved by taking into account the frequency of samples that shows exceedences. The first factor (scope) in the WQI formula seems also to have too much weight.

7. A REPORT ON THE APPLICATION OF THE CCME WATER QUALITY INDEX

AUTHOR: BERNIE NEARY

Gartner Lee Consultants

ABSTRACT:

The Canadian Council of Ministers of the Environment developed a Water Quality Index (WQI) in 2001. The WQI was designed as a reporting tool for water quality monitoring data, and produces a numeric rating of water quality based on how measurements meet or exceed defined objectives. A number of Canadian provincial and federal environmental monitoring agencies have used the WQI in the past year. A questionnaire was designed to determine the success with which the index has been applied. 35 users of the index identified strengths and weaknesses of the index, and rated it as a reporting and management tool. This report summarizes the early reaction of water quality professionals to the use of the index.

8. COMPARISON OF CANADIAN AND FRENCH WATER QUALITY INDICES

AUTHOR: HASEEN KHAN

Water Resources Management Division, Department of Environment
Government of Newfoundland & Labrador

ABSTRACT:

A comparative analysis is presented between aspects of the Canadian Water Quality Index (CWQI) and the French System of Evaluating Water Quality (SEQ-Eau), examining the aims of each index, basic principles and index methodology, strengths and weaknesses of each index, and a comparison of results using the same water quality data from Durance aux Mees (a river in the Alpes de Haute Province of France). The function of the CWQI is as a performance and communication tool. In addition to these aspects, the French SEQ-Eau also incorporates greater planning and management capabilities. The SEQ is actually a 3-part system for river quality assessment that evaluates the physical-chemical quality of water, the physical condition of the watercourse, and the status of biological communities. The foundation of the CWQI involves comparing water quality data to guidelines or objectives, and evaluating the scope, frequency and amplitude of failure. The SEQ-Eau groups similar parameters into 15 main indicators, compares all water quality data to corresponding guideline ratings curves, and produces index values for each indicator based on the least favorable sample from the least favorable parameter (taking into account the rule of 90%). Results from the CWQI and the SEQ-Eau using the same water quality data indicate a correlation in trend of index values, however, CWQI values are consistently lower than those of the SEQ-Eau by 10-30 index points. There are fundamental differences between the CWQI and the French SEQ-Eau, and both indices display different strengths and weaknesses. From the comparison of the two indices, it is apparent that more thought needs to be given to the CWQI as a planning tool, that the triggers of water quality problems need to be more easily identified within the CWQI, and that physical characteristics of the watercourse and biological health of the aquatic community are aspects that should be integrated into the CWQI.

9. WATER QUALITY MONITORING IN CANADA- WHERE ARE WE?

AUTHORS: ROBERT KENT, JANINE MURRAY, DON ANDERSEN, CHRIS LOCHNER, ISAAC WONG AND DAVE LAM

Water Quality Monitoring Branch, National Water Research Institute, Environment Canada

ABSTRACT:

As public awareness increases, so do the concerns and expectations relating to water quality and the overall health of Canadian freshwater ecosystems. In Canada, responsibility for assessing and managing water quality and aquatic ecosystem health is shared by all levels of government, with significant contributions by industry, academia, and non-government organizations. Due to this wide range of practitioners, there are many water quality related programs, activities and partnerships. However, there is currently no established national or *Canada-wide* water quality monitoring program or network in Canada. As a result, monitoring and surveillance activities are temporally and spatially fragmented; individual networks remain unlinked; monitoring of some key issues and stressors is lacking; and the data and information generated by monitoring activities is often not fully exploited. Consequently, water quality scientists and managers are seriously challenged to provide a comprehensive, national picture of the status and trends of water quality in Canada.

To address these critical issues, in May 2001, CCME Ministers agreed to *link existing water quality monitoring networks to ensure Canadians have access to comprehensive information on water quality*. A Monitoring Sub-Group was established under the CCME Water Quality Task Group to focus efforts on this commitment as part of the Ministers' action plan on water. Progress to date includes a national experts workshop on water quality monitoring (October 2002), a national inventory of water quality monitoring activities in federal and provincial jurisdictions, and initiation of a project to prepare a Canada-wide Framework for Water Quality Monitoring.

The CCME Water Quality Index is an important and effective reporting tool for synthesizing complex water quality information into simple, understandable terms. Fundamental to its success is the scientific value and strategic utility of our collective monitoring programs. As the index is dependent on the monitoring data that is being generated, it must be acknowledged that (significant) monitoring gaps exist. The requirements of the WQI should not direct monitoring efforts *per se*; rather monitoring (and reporting) should be guided by the questions raised by the public, science and management communities. The aim is to encourage and facilitate strategic monitoring programs that are driven by current scientific and policy issues, and that provide a balance between the generation of targeted data and the timely and sound interpretation and reporting of this information to Canadians.

10. APPLICATION OF CCME WATER QUALITY INDEX (CCME WQI) TO VARIOUS SITES IN THE MACKENZIE RIVER BASIN

AUTHORS: ASHOK LUMB¹, DOUG HALLIWELL² AND TRIBENI SHARMA³

¹EMAN Coordinating Office, KID, Environment Canada, CCIW, 867 Lakeshore Road, Burlington, ON, Canada L7R 4A6; ²Ecosystem Health Assessment Section, ERD, ECB, Environment Canada, Prairie & Northern Region, Yellowknife, NT; ³St. Francis Xavier University, Antigonish, NS
(Author for correspondence Email: ashok.lumb@ec.gc.ca; Tel: 905 336-4413; Fax: 905 336 4499)

ABSTRACT:

CCME WQI summarizes complex water quality data, making it more understandable to public, water distributors/planners/managers, and policy makers. CCME WQI incorporates three factors: **Scope** (*F1*); **Frequency** (*F2*); and **Amplitude** (*F3*) and produces numbers between 0 (worst) to 100 (best) water quality. An Excel Macro automates evaluation, facilitating presentation of results. The Macro is flexible, using <400 variables for calculations, with threshold values dictated by water quality standards (CCME based, site specific etc.) imposed for various uses (e.g. drinking, aquatic, overall).

Site-specific standards can be determined through statistical analysis of historical data. Statistical parameters of data series (both for entire and flood/freshet periods) can be calculated as threshold values (e.g. mean +2 standard deviation (SD), 90th percentile). Sets of water quality variables can be grouped together to constitute particular water uses or applications, discerning impacts on the water quality. Different threshold values can be applied to particular sets of quality variables, comprising the 11 protocols for analyses presented here for evaluating water quality of Mackenzie River basin (MRB).

In general, water quality in MRB is not impacted by nutrient loadings. However, elevations of physical and trace metal water quality variable values are common, necessitating the appropriate pretreatment of water before municipal and aquatic uses. The site specific objective functions in terms of the 90th percentile seem to show some promise, but should be tested rigorously before they are recommended for use. The mean +2 SD yardstick both for the entire data base and freshet period turned out to be less satisfactory.

11. REPORTING ON THE WATER QUALITY INDEX THROUGH CISE; NEWFOUNDLAND PILOT STUDY

AUTHORS: GEOFF HOWELL¹ AND HASEEN KHAN²

¹Integrated Environmental Applications Branch, Knowledge Integration Directorate,
Environment Canada

² Water Resources Management Division, Department of Environment
Government of Newfoundland & Labrador

ABSTRACT:

The Canada and Newfoundland/Labrador Aqua Link (CANAL) is a collaborative project under the Canada Newfoundland Water Quality Monitoring Agreement. This project was designed to develop inter-operable solutions that dynamically link several databases managed by both federal and provincial agencies.

CANAL uses a mapping interface to provide direct access to detailed information for over 100 water quality stations in Newfoundland and Labrador. "Burrowing down" from the map, users can get detailed station and watershed profiles, extract all water quality data for the station and view individual samples. CANAL also automatically charts coliform data and calculates and presents the CCME Water Quality Index calculations for drinking water, recreation and aquatic life. Technical development of an automated internet web service for WQI calculation that can be applied to any water quality database is nearing completion.

12. APPLICATION OF THE WATER QUALITY INDEX TO SEDIMENT OF THE LOWER GREAT LAKES

AUTHORS: SCOTT PAINTER, DR. CHRIS MARVIN AND DR. LEE GRAPENTINE

Environment Canada, PO Box 5050 Burlington, ON, L7R 4A6

ABSTRACT:

A sediment quality index (SQI) was developed from the metrics used in the recently approved Canadian Water Quality Index. The SQI_a was calculated according to an equation incorporating three elements; scope – the % of variables that did not meet guidelines; area frequency – the % of failed tests relative to the total # of tests in a group of sites, and; amplitude – the magnitude by which the failed variables exceeded guidelines. A modified SQI_s was also developed, using only the scope and amplitude elements, which computed the Index score per site with no grouping of sites. The SQI was applied to the assessment of sediment quality in Lakes Erie and Ontario and several Areas of Concern. The SQI represented the sediment quality data for over 30 chemicals, satisfactorily. The index therefore provides an opportunity to communicate an integrated assessment of many chemicals to a broader audience who simply wants to know “what does it all mean”. The index could be used by management to prioritize areas for further assessment or to communicate to the general public. The SQI has also been used in a weight of evidence approach that integrates surficial sediment chemistry, laboratory toxicity, invertebrate community structure and invertebrate tissue biomagnification data.

Appendix D: Guidance for Breakout Sessions

Overview of Breakouts

The CCME National Water Quality Index (WQI) Workshop is designed to identify a path forward for consistent implementation and effective reporting for the WQI at the national and regional level. Based on pre-workshop feedback from delegates and other interviewees – as summarized in the pre-workshop report prepared by Gartner Lee – the Steering Committee overseeing the workshop has identified five breakout topics for more in depth, small group working sessions during each day of the workshop. The five breakout topics are:

1. Key Inputs for Index Calculation;
2. Use of Water Quality Guidelines and Objectives;
3. Monitoring and Data;
4. Reporting and Communicating the WQI; and
5. Future Use of the WQI.

These breakout topics also reflect WQI implementation issues that have been raised by jurisdictions and other experts who have worked with the Index. These issues include: monitoring, inputs and guidance for calculating the Index, interpretation and use of the Index, communication and public expectation, long-term feasibility and commitment by governments.

Breakout Session Format and “Deliverables”

Each breakout session will explore one of the above topics and related sub-topics in detail over the two days of the workshop:

- Day 1 Breakout Sessions: 1:30 – 4:00 p.m.
 - Explore the issues/topics to be discussed
 - Identify potential opportunities/solutions to address each issue
 - Begin identifying recommendations
- Day 2 Breakout Sessions: 10:20 a.m. – 12 noon
 - Confirm recommendations to address each issue
 - Provide specific guidance with respect to each sub-topic and identify action steps needed to implement recommendations

It is anticipated that the “deliverables” from each breakout session will include:

- Recommendations for the topic area that will contribute to more consistent implementation and effective reporting for the WQI at the national and regional level, including:
 - Specific guidance pertaining to each recommendation; and
 - Action steps needed to implement the recommendation.

Key Inputs to Breakout Discussions

There are several important inputs that will inform the breakout discussions:

- The **pre-workshop paper**, which summarizes perspectives from workshop delegates and other interviewees (who have used the WQI) in response to a pre-workshop questionnaire;
- Several **pertinent background documents** (available at registration), including the draft report from the Atlantic Region WQI Pilot Study and a related paper assessing application of the pilot study methodology;
- **Plenary presentations** will discuss the development of the WQI, its early use, as well as challenges that need to be addressed to move towards more consistent implementation and effective reporting for the Index, both nationally and regionally;
- This “**Guidance for Breakout Sessions**” document, which outlines the issues and questions to be discussed in each breakout; and
- A concise **breakout session progress report** – which will be prepared on the evening of Day 1 and circulated to all participants at the beginning of Day 2 – to document progress and provide the foundation for final recommendations from participants at the conclusion of the workshop.

Breakout Session Topics and Focus Questions

The following pages provide more details on each breakout topic and sub-topics that will be addressed by the small groups.

As noted above, the five main breakout topics have been identified based on the results of the pre-workshop interviews.

Where appropriate, highlights from the pre-workshop interviews and Gartner Lee report have been included under each breakout topic, so that breakout participants can review, enhance and build on this feedback.

Breakout #1: Key Inputs for Index Calculation

Key Topics for Discussion:

There are several important inputs that can affect the output of the WQI. These include:

- The selection and number of water quality parameters;
- The frequency of sampling; and
- The period of time selected for Index calculation.

This breakout session will explore issues and opportunities for each of these key inputs. A separate breakout session will examine another key input to the WQI – the use of water quality objectives/guidelines.

This session will not address the current formulation of the WQI, but rather will consider issues and options relating to the above key inputs, which could potentially lead to the need to revisit the WQI formulation in the future.

Topic #1: Selection of Water Quality Parameters

Current WQI Approach: The WQI is completely flexible as to what parameters can be used to calculate the Index. The WQI Technical Report recommended a minimum of four parameters be used to calculate the index, but gave no guidance as to which parameters were appropriate.

The current approach varies by jurisdiction – several try to use as many variables as possible when calculating the index while others, such as British Columbia, make a concerted effort to focus only on those variables that reflect human activity in the watershed.

Feedback from Pre-Workshop Interviewees:		
<u>Strengths</u>	<u>Key Concerns/Issues</u>	<u>Potential Opportunities/Solutions</u>
<ul style="list-style-type: none"> • Flexibility • Versatility 	<ul style="list-style-type: none"> • Lack of comparability between sites • Potential for misuse or misinterpretation 	<ul style="list-style-type: none"> • Sub-indices? • Core set of parameters? • Guidance on which parameters for specific sites

Selection of Water Quality Parameters

More food for thought...

- Are there parameters that should always be included?
- Are there parameters that should never be included?
- Are there parameters that might be included only sometimes? Under what circumstances?
- What is the maximum/minimum number of parameters for a valid/stable index calculation?
- What are the essential parameters to include to calculate the WQI for specific uses (e.g., recreational use)?
- If there is time to discuss: Could a sub-index be calculated for a particular group of parameters (e.g., pesticides)?

Topic #2: Frequency of Sampling

Current WQI Approach: The CCME WQI Technical Manual recommends a minimum of four sampling visits per year.

Feedback from Pre-Workshop Interviewees:

<u>Strengths</u>	<u>Key Concerns/Issues</u>	<u>Potential Opportunities/Solutions</u>
<ul style="list-style-type: none"> • Minimal data sets can be used to calculate index 	<ul style="list-style-type: none"> • Sensitivity analyses have not been conducted 	<ul style="list-style-type: none"> • Form subgroup to complete sensitivity analysis?

Frequency of Sampling

More food for thought...

- How many times per year should sampling be done?
- What is the minimum number of samples per year needed to include a station in the index calculation? (Does this tend to vary by parameter?)

Topic #3: Period of Time Selection

Current WQI Approach: There is no guidance as to the appropriate time period for application. The Technical Report suggests that four samples within a year can be used to calculate the Index, but there is no real discussion of trend-through-time, although several examples of trend analysis are presented. As a result, the period of time selected for Index use has varied among jurisdictions according to data sets available and use of the report.

Feedback from Pre-Workshop Interviewees:		
<u>Strengths</u>	<u>Key Concerns/Issues</u>	<u>Potential Opportunities/Solutions</u>
<ul style="list-style-type: none">• Has been applied in trend-through-time applications.• Adaptable to many data sets	<ul style="list-style-type: none">• No guidance given on time selection• Little guidance given on how differing sampling frequency influences index output	<ul style="list-style-type: none">• Pilot application on well-characterized time series?

Period of Time Selection
<p><i>More food for thought...</i></p> <ul style="list-style-type: none">• Should the time period over which the Index is calculated be standardized?• What is a reasonable time period for calculating the running average (e.g., 3 or 4 years)?

Questions from Workshop Organizers

1. Looking at the “key topics for discussion” and list of sub-topics above, and thinking about the overall topic – Index Calculation – for this breakout session...

Do you feel there are any *additional* major topics or issues relating to this topic area that need to be addressed to move towards consistent implementation and effective reporting for the WQI?

Now, looking at each topic area...

2. What do you see as the key strengths of the current WQI?
3. What weaknesses need to be addressed?
4. What potential solutions should be considered?
5. What solution(s) do you recommend?
 - What specific guidance can you provide to assist with implementing this recommendation? (For example, see the “food for thought” questions)
 - What action steps need to be taken to implement this recommendation?

Breakout #2: Use of Water Quality Guidelines and Objectives

Key Topics for Discussion

Water quality objectives/guidelines are a critical input to the WQI. They provide the benchmarks against which water quality is assessed using the Index. Therefore the numerical values of the objectives/guidelines used have a huge impact on whether the WQI returns a good or poor result, and indices calculated using different sets of water quality guidelines (e.g., CWQG or provincial guidelines) are not directly comparable. Consistent use of the same set of WQGs (e.g., Canadian WQGs) would alleviate this problem; however, national guidelines may not always be appropriate for site-specific or regional analyses.

This breakout session will explore issues and opportunities relating to the use of water quality objectives/guidelines in the WQI, with the goal of providing recommendations that will lead to more consistent implementation and effective reporting for the WQI at the national and regional level.

Current WQI Approach: The WQI Technical Report recommends that at least four parameters be used at a site to calculate an index value, but there is no guidance as to which objectives or guidelines should be used. The original British Columbia WQI used site-specific guidelines, while other applications have mostly used Canadian water quality guidelines. Using national guidelines objectives can, however, result in poor index values for “pristine” areas. This results in those jurisdictions actually having to develop some sort of correction (including developing site-specific objectives) in order that output from the Index is truly representative for the site.

Feedback from Pre-Workshop Interviewees:

<u>Strengths</u>	<u>Key Concerns/Issues</u>	<u>Potential Opportunities/Solutions</u>
<ul style="list-style-type: none"> • Flexibility • Versatility • Addresses regional variations in water quality • Can be used to rate water quality for different purposes (protection of aquatic life, irrigation, stock watering...) 	<ul style="list-style-type: none"> • Index values calculated with different objectives can't be compared • Index ratings can be manipulated by setting site specific objectives that are easy to meet • Using national objectives can result in poor WQ ratings for pristine systems • Many parameters are monitored for which no guidelines or objectives have been developed 	<ul style="list-style-type: none"> • Development of regional or site-specific objectives? • Guidance for a consistent approach to developing of site-specific objectives? • Ensure guidelines exist for keystone parameters?

Use of Water Quality Objectives/Guidelines

More food for thought...

- Should national guidelines be used where possible to standardize use or should site-specific guidelines be used where possible to better reflect local conditions? Should a mix of the two be used?
- What should be done if there are no guidelines?
- What should be done in cases where there are high natural background levels for certain parameters (e.g., certain metals in Atlantic Canada)?

Questions from Workshop Organizers

1. Looking at the “key topics for discussion” and “food for thought” above ...

Do you feel there are any *additional* major topics or issues relating to this topic area that need to be addressed to move towards consistent implementation and effective reporting for the WQI?

Now, looking at current WQI approach for using guidelines and/or objectives...

2. What do you see as the key strengths of the current WQI?
3. What weaknesses need to be addressed?
4. What potential solutions should be considered?
5. What solution(s) do you recommend?
 - What specific guidance can you provide to assist with implementing this recommendation? (For example, see the “food for thought” questions)
 - What action steps need to be taken to implement this recommendation?

Breakout #3: Monitoring and Data

Key Topics for Discussion

Users of the WQI need more guidance on how to deal with monitoring related issues (e.g., what data is available and what is not, inconsistencies, analytical advances) within the confines of existing jurisdictional water quality monitoring programs. One of the goals of the workshop is to link the WQI to the proposed national water quality monitoring framework (NWRI). Moreover, there are opportunities to develop a national distributed database through the CISE Water Initiative.

Current WQI Approach

The WQI is designed to work with virtually any data set that meets minimum requirements (four parameters, four samples per year). This flexibility makes the Index versatile, but means that the reporting must be carefully qualified to describe exactly what data was used to calculate it.

Currently users apply the Index where data are available – in some cases using all available data even if not justified by the human uses in the watershed. This inconsistency in approach leads to differences in outputs from the index, as well as perception that the index itself is a problem.

Feedback from Pre-Workshop Interviewees:		
<u>Strengths</u>	<u>Key Concerns/Issues</u>	<u>Potential Opportunities/Solutions</u>
<ul style="list-style-type: none"> • Most agencies collect data sufficient to derive the Index • Index can be calculated on many different data sets 	<ul style="list-style-type: none"> • Inconsistencies in parameters, collection and analytical methods make site comparisons difficult • The WQI is a reporting, not a management tool. Data should not be collected just to 'feed' the Index 	<ul style="list-style-type: none"> • Guidance on the use of data sets with variable analytical methods • Standardization of some collections without compromise of monitoring requirements

Monitoring and Data

More food for thought...

- For the purposes of the WQI, are our monitoring programs addressing the key public, science and policy questions that are being raised (e.g., safety of drinking water sources)?
- How does the WQI need to respond/adapt in the face of changing water quality monitoring programs? (Not many of these monitoring programs are long-term, so how does this impact the WQI?)
- Should a national interactive database for water quality and quantity be developed? If so, what considerations need to be taken into account?
- How do we address the need for stable, long term, ambient monitoring to support the WQI and other WQ reporting in Canada?
- Geographic sampling and representation: What breadth and density of ambient monitoring is required to provide a valid national picture using the WQI? A valid regional picture?
- Should the focus of ambient monitoring and calculation of the WQI be on the highly populated portions of the country?

Questions from Workshop Organizers

1. Looking at the “key topics for discussion” and “food for thought” above ...
Do you feel there are any *additional* major topics or issues relating to this topic area that need to be addressed to move towards consistent implementation and effective reporting for the WQI?

Now, looking at current WQI approach to address monitoring and data considerations...

2. What do you see as the key strengths of the current WQI?
3. What weaknesses need to be addressed?
4. What potential solutions should be considered?
5. What solution(s) do you recommend?
 - What specific guidance can you provide to assist with implementing this recommendation? (For example, see the “food for thought” questions)
 - What action steps need to be taken to implement this recommendation?

Breakout #4: Reporting and Communicating the WQI

Key Topics for Discussion

The WQI is a communication tool for simplifying the reporting of water quality data. The WQI fills a reporting gap by providing meaningful summaries of overall water quality, while producing output that is accessible to all Canadians. There is a need to elaborate and understand the requirements for reporting the WQI at the national, regional, and local levels (i.e., consistent messages, interpretation, similarities and differences across the geographical scales, audience). The output from the WQI can be provided to the public with as much additional information as is desired by the jurisdiction. For example, the output in British Columbia uses a succinct question and answer format, differing from what has recently been done in the Atlantic Provinces where more detailed explanations have been provided.

In addition, a balance must be struck between desired flexibility inherent in the WQI and standardization that is required in order to have meaningful comparisons.

This breakout will explore:

- **Key target audiences** for the WQI (general public, educators/students, scientific/technical audience, managers/decision-makers) and the best ways to reach these audiences.
- **Requirements for reporting** the WQI at the local, regional and national levels (consistent messages, interpretation, similarities and differences across geographic scales).
- **Flexibility versus standardization:** the balance between the inherent flexibility in the WQI and the standardization that is required to have meaningful comparisons (i.e. does it change for different geographic scales).
- Time permitting... **Promotion of the WQI** as an effective communication and reporting tool.

Current WQI Approach

The WQI produces a “one-number” answer to the complex issue of water quality assessment. Further, there are categories for Index results that rate the water quality as “excellent”, “good”, “fair”, etc. The WQI Technical Report suggested that the preliminary categories required refinement after further testing of the Index.

Feedback from Pre-Workshop Interviewees:

<u>Strengths</u>	<u>Key Concerns/Issues</u>	<u>Potential Opportunities/Solutions</u>
<ul style="list-style-type: none">• Understandable by non-technical audiences• Easy to explain• Easy to calculate	<ul style="list-style-type: none">• Categories are questionable• Oversimplifies complex situation• Qualification of the index may be lost in “sound bites”• Potential misuse	<ul style="list-style-type: none">• Further examination of categories?• Standardized approach to reporting Index values?

Topic #1: Key Target Audiences for the WQI

More food for thought...

- Which are the key audiences for the WQI: general public? educators/students? scientific/technical audience? managers/decision-makers? For what purpose?
- How can the WQI be made more useful for certain audiences? (messages, interpretation , report format, electronic format)
- Is there an opportunity to drill down to specific data that would be of interest to specific audiences? What information for which audiences?
- Does the purpose and use of the WQI differ for an audience depending on the geographic level at which it is reported? (local, regional, national)

Topic #2: Requirements for Reporting the WQI at the Local, Regional, and National Levels

More food for thought...

- Does reporting of the WQI serve different purposes at the different geographic scales, or is it essentially the same?
- What kinds of messages and interpretation/caveats are valid/less valid for reporting the WQI at the local, regional/provincial and national scales?
- Format: Is the format of reporting the distribution of WQI scores (from poor to excellent) as a bar chart the most user friendly and scientifically valid? Are there better formats/statistical measures?
- Does the requirement for standardization of beneficial uses reported, WQ objectives used, parameters, time periods, frequency of sampling change at different geographic scales?
- What are reasonable requirements for geographic representation to report regionally, nationally?

Topic #3: Flexibility versus Standardization

More food for thought...

- The WQI calculation process is itself a standardized approach; do all parameters, time periods, sampling frequencies, etc. have to be standardized in order to report in a meaningful way at the regional/national level? What are the limits? Caveats?
- Is it fair/valid to say that more standardization is needed at the local/regional level and less at the national level for meaningful reporting? What caveats/messages are necessary?
- Are there inputs to the WQI calculation that absolutely must be standardized for meaningful reporting? To make comparisons?

Topic #4: TIME PERMITTING...Promotion of the WQI as a communications and reporting tool

More food for thought...

- What actions will be most effective:
 - More active promotion by the CCME?
 - Use for national reporting?
 - More guidelines for practitioners?
 - More pilot studies?
 - Education of managers?
 - Other?

Questions from Workshop Organizers

1. Looking at the “key topics for discussion” and “food for thought” above ...

Do you feel there are any *additional* major topics or issues relating to this topic area that need to be addressed to move towards consistent implementation and effective reporting for the WQI?

Now, looking at current WQI approach to reporting and communication...

2. What do you see as the key strengths of the current WQI?
3. What weaknesses need to be addressed?
4. What potential solutions should be considered?

5. What solution(s) do you recommend?

- What specific guidance can you provide to assist with implementing this recommendation? (For example, see the “food for thought” questions)
- What action steps need to be taken to implement this recommendation?

Breakout #5: Future Use of the WQI

Key Topics for Discussion

While a communication tool, it may be possible to adapt the WQI for a variety of different applications (e.g., trend analysis, sector use), some even beyond reporting (e.g., performance tracking). The WQI could become part of a series of indices including a sediment quality index, a soil quality index, and a biodiversity index for different water and land uses (e.g., aquatic life, drinking water, agricultural land use, industrial land use). The long-term feasibility and commitment by governments needs to be addressed.

Feedback from Pre-Workshop Interviewees:

- Some respondents want the Index to be used for a national or regional assessment
- Concerns expressed that monitoring may be compromised to “feed” the index
- Some concern that the WQI may be misused as a management tool

Questions from Workshop Organizers

1. Is it appropriate or feasible to adapt the WQI to enable reporting by sectoral use (e.g., agriculture, forestry, mining, etc.)? If so, what would need to be done to make this happen?
2. Is there potential to adapt the WQI to enable trend analysis? If so, what would need to be done to make this happen?
3. Is there potential for applications of the WQI beyond reporting and communication? (e.g., for decision-making; for performance indicators, etc.) If so, what would need to be done to make this happen?
4. Is there potential to include the WQI in a series of indices, perhaps including a sediment quality index, a soil quality index, and a biodiversity index for different water and land uses (e.g., aquatic life, drinking water, agricultural land use, industrial land use)? If so, what would need to be done to make this happen?
5. What can/should be done to enhance the long-term feasibility of the Index and commitment by governments to apply the WQI?